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Project No. 13-400

Stonecap Trading 14 (Pty) Ltd

01st November 2016

GCS (Pty) Ltd

PO Box 2597,

RIVONIA

2128

South Africa

Attention: Estie Retief/Riana Panaino,

Dear Estie/Riana,

Matla Stooping Project

Amendment to the Baseline Specialist Soils, Land Use and Land Capability Studies,

Environmental Impact Assessment and Environmental Management Plan

Exxaro – Matla Colliery

Attached herewith please find the amendment to the draft of our specialist report detailing the findings of the soils and land capability studies submitted in terms of the environmental authorisations being planned for the Underground mining (Stooping) at Matla Colliery.

As part of the on-going feasibility studies for Matla Colliery, the specialist soils, land use and land capability have been investigated and the pre mining conditions captured as part of the baseline considerations for the stooping of the pillars from the underground workings.

This information has been used as the basis for the assessment of the impacts and the development of a management plan.

Please do not hesitate to contact us should you require any additional information in this regard.

Thanking you.

Yours faithfully,

Earth Science Solutions (ESS) (Pty) Ltd

Ian Jones B.Sc. (Geol) Pr.Sci.Nat EAPASA Certified

Director

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EIA – SOILS REPORT V1.6a

Sustaining the Environment

EXXARO MATLA COAL MINE'S PROPOSED STOOPING PROJECT

REVISED
BASELINE INVESTIGATION, EIA & EMP SPECIALIST
SOILS, LAND USE AND LAND CAPABILITY STUDIES

Compiled For

November 2016

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Foreword

These Specialist Studies (Soils, Land Capability and Land Use) have been compiled for a Section 102 Amendment of the Minerals and Petroleum Resources Development Act (No. 28 of 2002) ("MPRDA"). A Section 102 Amendment requires a Scoping and Environmental Impact Assessment (EIA) which is detailed in the requirements for the submission of an "Application for a Mining Right" as set out under Section 22 of the MPRDA.

The Exxaro Matla Coal Mine – Proposed Stooping Project is part of an on-going development being undertaken in consideration of the mining of the pillars from the underground sections of the coal resource situated to the south and west of town of Kriel in the Mpumalanga Province (South Africa).

The mining project requires that a number of specialist studies be undertaken as part of the application being made in terms of the MPRDA legislation. The specialist soils, land use and land capability studies are undertaken as support information required in terms of the larger EIA and Environmental Management Programme (EMP) being undertaken by GCS (Pty) Ltd, the lead consultants executing the project on behalf of Exxaro.

The MPRDA (2002) specifies various requirements for the environmental scoping and amendment of a project. These include both the physical as well as the social and economic aspects. This document covers three of the physical aspects, namely:

- The Pedological (Soils) Study;
- The Land Capability Rating;
- The Pre Development Land Use Assessment.

Declaration

The specialist Pedological and Land Capability studies where managed and signed off by Ian Jones (Pr. Sci. Nat 400040/08), an Earth Scientist with 34 years of experience in this field of expertise.

I declare that both, Ian Jones, and Earth Science Solutions (Pty) Ltd, are totally independent in this process, and have no vested interest in the project.

The objectives of the study were to:

- Provide a permanent record of the present soil resources in the area that are potentially going to be affected by the proposed development – Pre mining environment;
- Assess the nature of the site in relation to the overall environment and its present and proposed utilisation, and determine the capability of the land in terms of agricultural utilisation; and
- Provide a base plan from which long-term ecological and environmental decisions can be made, impacts of mining can be determined, and mitigation and rehabilitation management plans can be formulated.

The Taxonomic Soil Classification System and Chamber of Mines Land Capability Rating Systems were used as the basis for the soils and land capability investigations respectively. These systems are recognized nationally.

Signed: November 2016

Ian Jones B.Sc. (Geol) Pr.Sci.Nat 400040/08

Director

EXECUTIVE SUMMARY

The specialist soil, land use and land capability studies in conjunction with the impact assessment and management planning have been prepared in terms of Section 22 of the Minerals and Petroleum Resource Development Act (MPRDA) (No. 28 of 2002), and submitted as part of the motivation for the amendment of the of Mining Right under Section 102 of the MPRDA, for the inclusion of the Matla Coal Mine's proposed Stooping Project area.

In addition, a full and comprehensive Scoping and EIA and EMP are to be compiled in terms of the MPRDA requirements.

This report details the findings of the baseline investigations for the proposed stooping (extraction of pillars) of the coal pillars from all of the selected areas in the underground sections, and the transportation of the raw material for beneficiation. The development plan and project description are confined at this stage to the surface areas that are owned by Exxaro Coal Mpumalanga and Eskom. The other areas have been considered separately in terms of the impact significance rating as the development plan has still to be finalised, and as such the specifics of the mining plan could change.

Based on the draft mining and development plan at hand, the potential impacts of stooping have been assessed, and mitigation has been considered in line with the minimum requirements and best practice guidelines, with a soil utilisation plan considered as part of the management design and implementation.

The mining of the deep seated (generally >70m) coal seams by underground bord and pillar and long wall mining methods has been completed successfully for large portions of the Matla Coal Mine's coal deposits. However, these methods of mining result in significant quantities of raw coal being left *in-situ*, and the loss of a valuable tonnage of raw material.

This project does not consider the transportation and/or beneficiation of the raw product as these are already covered in the authorised mining right. It is understood however that the cumulative effects of raw material stockpiles, conveyer lines and the position of surface infrastructure are significant to the proposed stooping exercise, particularly where the potential for surface subsidence is concerned and the potential for negative impacts could occur as a result.

The potential impact footprint is relatively large, and cognisance has been taken of the surface features that could be affected as part of the mine planning. Stooping will potentially result in the subsidence of the surface topography with the possibility of long term negative results. Awareness and management of these effects at surface will minimise and help to mitigate the impacts. It is envisaged however that the topographic changes that will occur as a result of stooping will result in changes to the overall geomorphology and soils, land capability and land use of the area in the long term, with definite impacts on the eco-system services.

In light of these concerns and possible negative impacts the proponent (Exxaro Matla Coal Mpumalanga and Eskom) is planning to only mine under areas of land that they own.

In turn, the development of a management strategy that will assist in the mitigation of the potential impacts is required based on the impact assessment.

The specialist soils and land capability information is tabled in terms of the South African Legislation and guidelines, with the principles for best practice being followed in terms of the International Finance Corporation (IFC) Performance Principles (a set of internationally accepted guidelines and principles for sustainable development).

The results of the baseline study indicate that the stooping development could potentially impact some areas with moderately sensitive to sensitive soil forms. The probability is moderate to low, but the potential for subsidence at surface due to underground collapse has historically been a problem for land owners and the environment. The land capability is for the most part considered to have at best a moderate or poor arable land capability rating or moderate grazing land capability rating.

The soils range from fine textured loams and silty clay loams on the in-situ derived materials to structured, and clay rich pedocutanic to gleyed materials where they are associated with colluvial and alluvial deposition. The soil chemistry is reflective of the parent lithologies from which they are derived, comprising for the most part carbon (organic) poor and nutrient deficient soils with a moderate water holding capability and underlying inhibiting layer (hard rock or ferricrete), factors important to the soil drainage, vadose water and the overall balance to the ecology of these sites

In general, the soil as a resource is considered as sensitive to highly sensitive as this is the stabilising medium through which the plants and animals sustain life, where water is stored and utilised and the rooting of vegetation is able to control erosion and the loss of the resource to the surface water bodies.

Soil wetness and the presence of hydromorphic conditions are considered important characteristics and these environments are rated as highly sensitive, and areas that need to be flagged as “No Go” or sites requiring special attention. A number of the activities being planned will impact directly on sensitive and in places highly sensitive sites, or are associated with the zone of influence that could affect these sites.

The land was historically used for winter grazing, with grasslands being the natural land/veld type. However, present farming activities have resulted in the cultivation of large tracts of land and converted the land use to commercial agriculture, inclusive of livestock grazing.

The mining activities proposed could, if not well managed, have a moderate to high negative impact on a significantly large surface area. This is especially true if the stooping operation is not well engineered and managed (collapse and subsidence). Detailed geotechnical studies should be undertaken to better understand what the effects of stooping will have on the surface environment, with emphasis on obviating the effects of collapse and resultant ponding that is inevitable if the existing land form is disrupted and the free draining nature of the topography is deformed by surface collapse.

The loss of the soil as a resource is of concern in the consideration of any new development where they are going to be disturbed. The effects of mining activities will potential result in salinisation and/or contamination due to dirty water accumulations (lack of free draining and water management), sterilisation due to leaching of the soils, erosion by wind and/or water on areas where the cover materials are disturbed/removed and/or where the topography and slopes are altered, compaction due to uncontrolled access over unprotected soils, and the possibility of spillage and contamination by hydrocarbons or raw product. All of these effects will be detrimental to the capability of the land as well as changing the long term end land use.

The overall impacts significance rating of stooping on the soils, land use and land capability is considered to be moderate to high negative in the unmanaged state. However, with a well-structured and engineered mining plan and the implementation of the soil management measures, mitigation is possible and can be adequately instituted to acceptable levels of risk and a sustainable project realised.

GLOSSARY OF TERMS

Alluvium: Refers to detrital deposits resulting from the operation of modern streams and rivers.

Base status: A qualitative expression of base saturation. See base saturation **percentage.**

Buffer capacity: The ability of soil to resist an induced change in pH.

Calcareous: Containing calcium carbonate (calcrete).

Catena: A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic conditions, but having different characteristics due to variation in relief and drainage.

Clast: An individual constituent, grain or fragment of a sediment or sedimentary rock produced by the physical disintegration of a larger rock mass.

Cohesion: The molecular force of attraction between similar substances. The capacity of sticking together. The cohesion of soil is that part of its shear strength which does not depend upon inter-particle friction. Attraction within a soil structural unit or through the whole soil in apedal soils.

Concretion: A nodule made up of concentric accretions.

Crumb: A soft, porous more or less rounded ped from one to five millimetres in diameter. See structure, soil.

Cutan: Cutans occur on the surfaces of peds or individual particles (sand grains, stones). They consist of material which is usually finer than, and that has an organisation different to the material that makes up the surface on which they occur. They originate through deposition, diffusion or stress. Synonymous with clayskin, clay film, argillan.

Desert Plain: The undulating topography outside of the major river valleys that is impacted by low rainfall (<25cm) and strong winds.

Denitrification: The biochemical reduction of nitrate or nitrite to gaseous nitrogen, either as molecular nitrogen or as an oxide of nitrogen.

Erosion: The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

Fertiliser: An organic or inorganic material, natural or synthetic, which can supply one or more of the nutrient elements essential for the growth and reproduction of plants.

Fine sand: (1) A soil separate consisting of particles 0,25 - 0,1mm in diameter.
(2) A soil texture class (see texture) with fine sand plus very fine sand (i.e. 0,25 - 0,05mm in diameter) more than 60% of the sand fraction.

Fine textured soils: Soils with a texture of sandy clay, silty clay or clay.

Hardpan: Massive material enriched with and strongly cemented by sesquioxides, chiefly iron oxides (known as ferricrete, diagnostic hard plinthite, ironpan, ngubane, ouklip, and laterite hardpan), silica (silcrete, dorbank) or lime (diagnostic hardpan carbonate-horizon, calcrete). Ortstein hardpans are cemented by iron oxides and organic matter.

Land capability: The ability of land to meet the needs of one or more uses under defined conditions of management.

Land type: (1) A class of land with specified characteristics. (2) In South Africa it has been used as a map unit denoting land, mapable at 1:250,000 scale, over which there is a marked uniformity of climate, terrain form and soil pattern.

Land use: The activity carried out on a portion of land.

Mottling: A mottled or variegated pattern of colours is common in many soil horizons. It may be the result of various processes *inter alia* hydromorphy, illuviation, biological activity, and rock weathering in freely drained conditions (i.e. saprolite). It is described by noting (i) the colour of the matrix and colour or colours of the principal mottles, and (ii) the pattern of the mottling.

The latter is given in terms of abundance (few, common 2 to 20% of the exposed surface, or many), size (fine, medium 5 to 15mm in diameter along the greatest dimension, or coarse), contrast (faint, distinct or prominent), form (circular, elongated-vesicular, or streaky) and the nature of the boundaries of the mottles (sharp, clear or diffuse); of these, abundance, size and contrast are the most important.

Nodule: Bodies of various shapes, sizes and colour that have been hardened to a greater or lesser extent by chemical compounds such as lime, sesquioxides, animal excreta and silica. These may be described in terms of kind (durinodes, gypsum, insect casts, ortstein, iron, manganese, lime, lime-silica, plinthite, salts), abundance (few, less than 20% by volume percentage; common, 20 – 50%; many, more than 50%), hardness (soft, hard - meaning barely crushable between thumb and forefinger, indurated) and size (threadlike, fine, medium 2 – 5mm in diameter, coarse).

Overburden: A material which overlies another material difference in a specified respect, but mainly referred to in this document as materials overlying weathered rock.

Ped: Individual natural soil aggregate (e.g. block, prism) as contrasted with a clod produced by artificial disturbance.

Pedocutanic, Diagnostic B-horizon: The concept embraces B-horizons that have become enriched in clay, presumably by illuviation (an important pedogenic process which involves downward movement of fine materials by, and deposition from, water to give rise to cutanic character) and that have developed moderate or strong blocky structure. In the case of a red pedocutanic B-horizon, the transition to the overlying A-horizon is clear or abrupt.

Pedology: The branch of soil science that treats soils as natural phenomena, including their morphological, physical, chemical, mineralogical and biological properties, their genesis, their classification and their geographical distribution.

Slickensides: In soils, these are polished or grooved surfaces within the soil resulting from part of the soil mass sliding against adjacent material along a plane which defines the extent of the slickensides. They occur in clayey materials with a high smectite content.

Sodic soil: Soil with a low soluble salt content and a high exchangeable sodium percentage (usually EST > 15).

Swelling clay: Clay minerals such as the smectites that exhibit interlayer swelling when wetted, or clayey soils which, on account of the presence of swelling clay minerals, swell when wetted and shrink with cracking when dried. The latter are also known as heaving soils.

Texture, soil: The relative proportions of the various size separates in the soil as described by the classes of soil texture shown in the soil texture chart (see diagram on next page).
The pure sand, sand, loamy sand, sandy loam and sandy clay loam classes are further subdivided (see diagram) according to the relative percentages of the coarse, medium and fine sand subseparates.

Vertic, diagnostic A-horizon: A-horizons that have both high clay content and a predominance of smectitic clay minerals possess the capacity to shrink and swell markedly in response to moisture changes. Such expansive materials have a characteristic appearance: structure is strongly developed, ped faces are shiny, and consistence is highly plastic when moist and sticky when wet.

1. INTRODUCTION AND PHYSIOGRAPHY

1.1 Introduction

The Exxaro Matla Coal Mine proposed Stooping project is considered a brownfields project in terms of mining, while the majority of the surface has been impacted by commercial agriculture, activities that have substantially altered the original grassland biome. It is from this baseline that the study has been undertaken, the measurement and record of the pre development conditions being an important aspect for the measure of sustainability for any project in the long term.

Commercial farming, inclusive of cultivation and grazing of livestock has disturbed the natural land use, soil conditions and land capability. In addition, the existence of on-going mining and associated activities has impacted the surface in a number of areas within the mining right boundary.

The effects of the existing activities are evident, with signs of erosion, areas of compaction and small but significant signs of contamination of the soils all having negative impacts on the ecosystem services, with varying degrees of soil degradation and the reduction in the land capability rating. Approximately 80% of the study area has been altered by the present activities (commercial farming and or mining), with only small areas of unaffected land still exist.

The pre development baseline has been characterised in terms of its geomorphological conditions and soil characteristics, and these facts have been used in developing a sustainable model for the development going forward.

Exxaro Matla Coal Mine have the right to explore and prospect for coal as part of the mining right that is held for the Matla Coal Mine. As part of the ongoing development and optimisation of the resource it has been proposed that the pillars of coal that have been left underground as support to the bord and pillar mining be removed. This is referred to as the "stooping" method of mining. This will negate the need for additional new mining development for some time and will increase the life of the mine and secure the coal resource to the power supply utilities in the area.

The downside to stooping is the inevitable collapse of the underground open void that is left after pillar removal and the potential for the subsidence to exhibit at surface. The undulating nature and variable thickness of the seam removed can potentially result in the formation of an undulating topography at surface that is not free draining, a situation that often results in the ponding of water and the potential for salinisation and contamination of the soils and soil water.

The support infrastructure for the underground mining will utilise the existing decline shafts and associated complexes (inclusive of ventilation shafts, administration workshops and offices), with access to the infrastructure and haulage of the raw material to the beneficiation works restricted to existing infrastructure and conveyancing systems.

Additional RoM stockpiles, and temporary water holding facilities and the possibility of treatment for dirty water might be needed. This is not catered for in this project.

There is no open cast mining envisaged as part of this amendment project and there will be no additional infrastructure required as part of this project.

The Matla Coal Mine Proposed Stooping Project will result in a number of changes and potential negative impacts at surface due to stooping of pillars and the resulting subsidence. The effects of subsistence at surface are a function of the depth of mining below the surface and the width of the mined out area underground.

The shallower the depth to the coal seam and the thicker the coal seam, the greater will be the effects at surface, while the deeper the mining and thinner the mined out area, the smaller will be the effect on the surface features. These include the soils, which in turn will have an effect on the land use and land capability.

In an attempt at quantifying the potential impacts that might result, and in order to meaningfully develop a management plan that will mitigate the effects of the planned activities, it is imperative that an understanding of the pre development aspects and baseline conditions are understood and documented.

Failure to achieve a stable and free-draining environment will result in salinisation of the soil profile due to the concentration of salts and chemicals/metals in the vadose water, which in turn would sterilise the soil resource and have an overall impact on the ecosystem services. The impacts have been assessed and the management and mitigation (soil utilisation plan) tabled as part of developing a sustainable project taking these issues into account.

Of concern and importance to the earth sciences, is an understanding of the socio economics and possible physical effects on the ecosystem services of the area, and the effects that the mining activities will have on the land owners and land occupiers that make a living or sustain themselves from the land (soils). This includes the effects that might be felt off site due to the erosion of soil by wind and water and the potential for siltation and contamination of the streams and rivers by suspended and dissolved solids.

One of the more important outcomes of the soil characterisation and classification assessment was the delineation and characterisation of the dominant soils and the rating of the soil sensitivity, a function of the soil morphology and the proposed activities to be imposed by the Matla Coal Mine's proposed Stooping Project. These aspects are considered meaningful tools and systems that can be used to identify areas that will require added inputs and/or consideration in terms of the natural environment (biodiversity offsets etc.) as well as the legal requirements and/or licensing.

In addition, the Department of Water and Sanitation and the National Department of Agriculture require that soil wetness and the agricultural potential of the soils are assessed as part of any baseline assessment of a new development, and that any areas of wetness and sensitivity are considered and highlighted for additional considerations.

The highly sensitive nature of shallow and wet based soils and their inherent importance in the functionality of the overall ecological cycle (sensitivity) have been noted as an important aspect of the baseline investigation, and used in measuring the relative impact significance.

The sensitive nature of the wet based and classified wetland soils is of concern not only for the important contribution that these materials render to the storage and supply of clean water to the vadose zone and base flow in rivers, but also with regard to the geotechnical and ground engineering properties (structure, texture etc.) when considering the re-instatement (rehabilitation) of the soils around areas of collapse. These materials are inherently higher in clay, more structured and generally more difficult to work, particularly in the wet state.

The Matla Coal Mine's Proposed Stooping Project will potentially/possibly impact on some of the wetland (wet based soils and transition zone materials). There will be no mining under areas of existing infrastructure.

This report has been compiled in line with the Hacking Guidelines, an Impact Assessment philosophy and Significance Rating System recognised by the DEA in terms of the NEMA (1998), as well as the International Finance Corporation (IFC) Performance Principles, a system recognised by the World Bank as a basis for best practise.

The impact assessment aims to identify and quantify the environmental and social aspects of the proposed activities, to assess how the activities will affect the existing state of the environment, and link the aspects to variables that have been defined in terms of the baseline study.

1.2 Project Description

The Exxaro Matla Coal Mine's Proposed Stooping Project is situated to the south of the town of Witbank and the west of Kriel, two of the larger centers in the region that support the agricultural and coal mining industries. Kriel is an important hub and urban center associated with mining and the generation of power in the Highveld region of the Mpumalanga Province in South Africa (Refer to Figure 1-2a – Locality Plan, and Figures 1.2b and 1.2c for the proposed mining plans).

The coal fields that are exploited in this area are part of the Highveld coalfields of South Africa, a series of coal seams associated with the Karoo sediments.

The Exxaro Matla Coal Mine's Proposed Stooping Project is considered a Brownfields Project in terms of mining, the extraction of coal from underground having been on-going since the early 1970's using a system of "bord and pillar" mining. The extraction of the pillars from these sections is being considered as part of an optimisation plan.

The Exxaro Matla Coal Mine's Proposed Stooping Project will cause subsidence that will express itself at surface. The impacts associated with subsidence are the issues that need to be understood and managed/mitigated as part of the environmental concerns and sustainability equation for the area.

The infrastructure required for the stockpiling, transportation and beneficiation of the raw material is already in place and is covered in terms of the existing authorisations for Matla Colliery. Figure 1.2b indicates the Exxaro Matla Coal Mine's Proposed Stooping Project areas that are under consideration for mining using the "stooping" mining method.

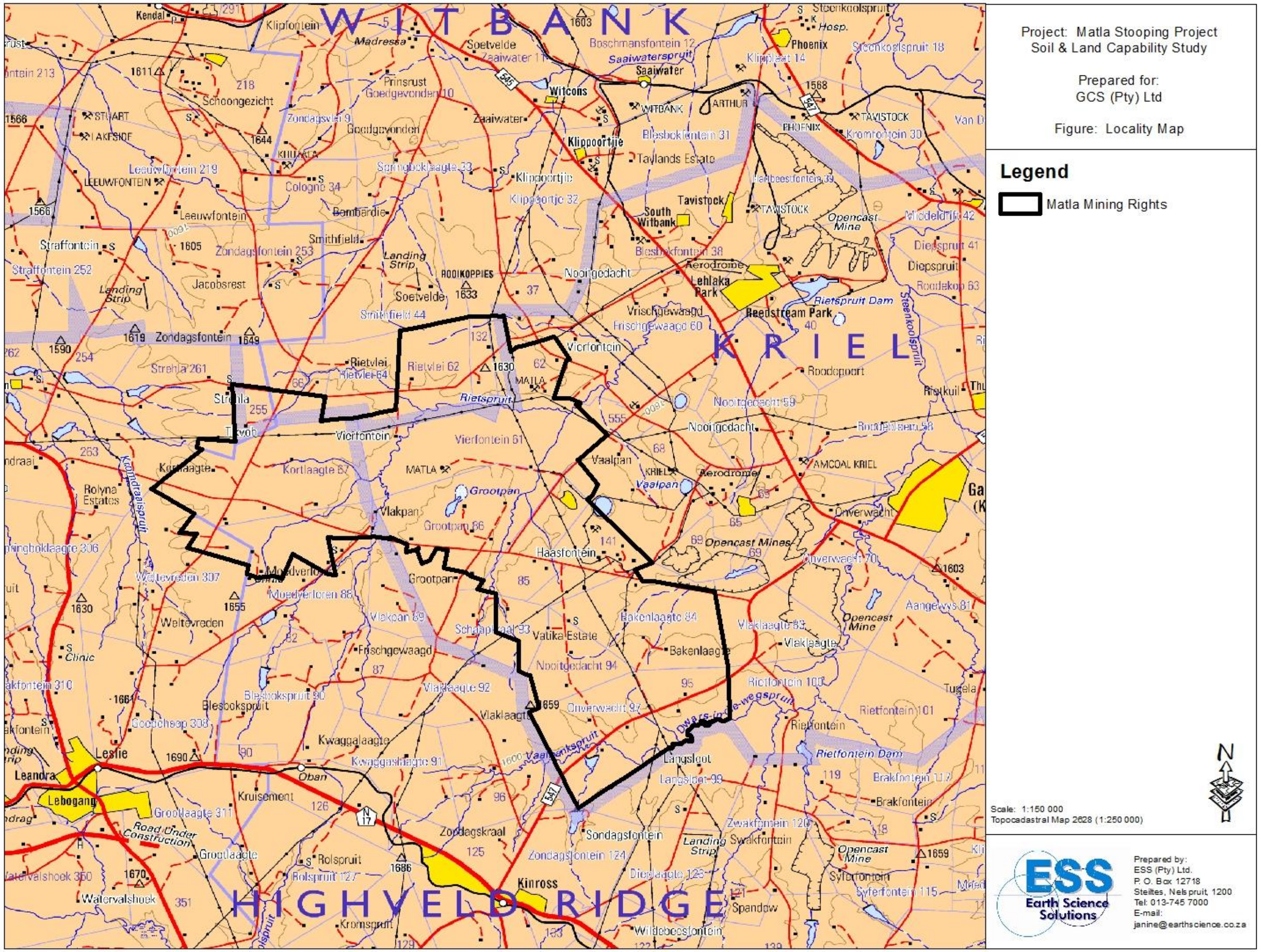
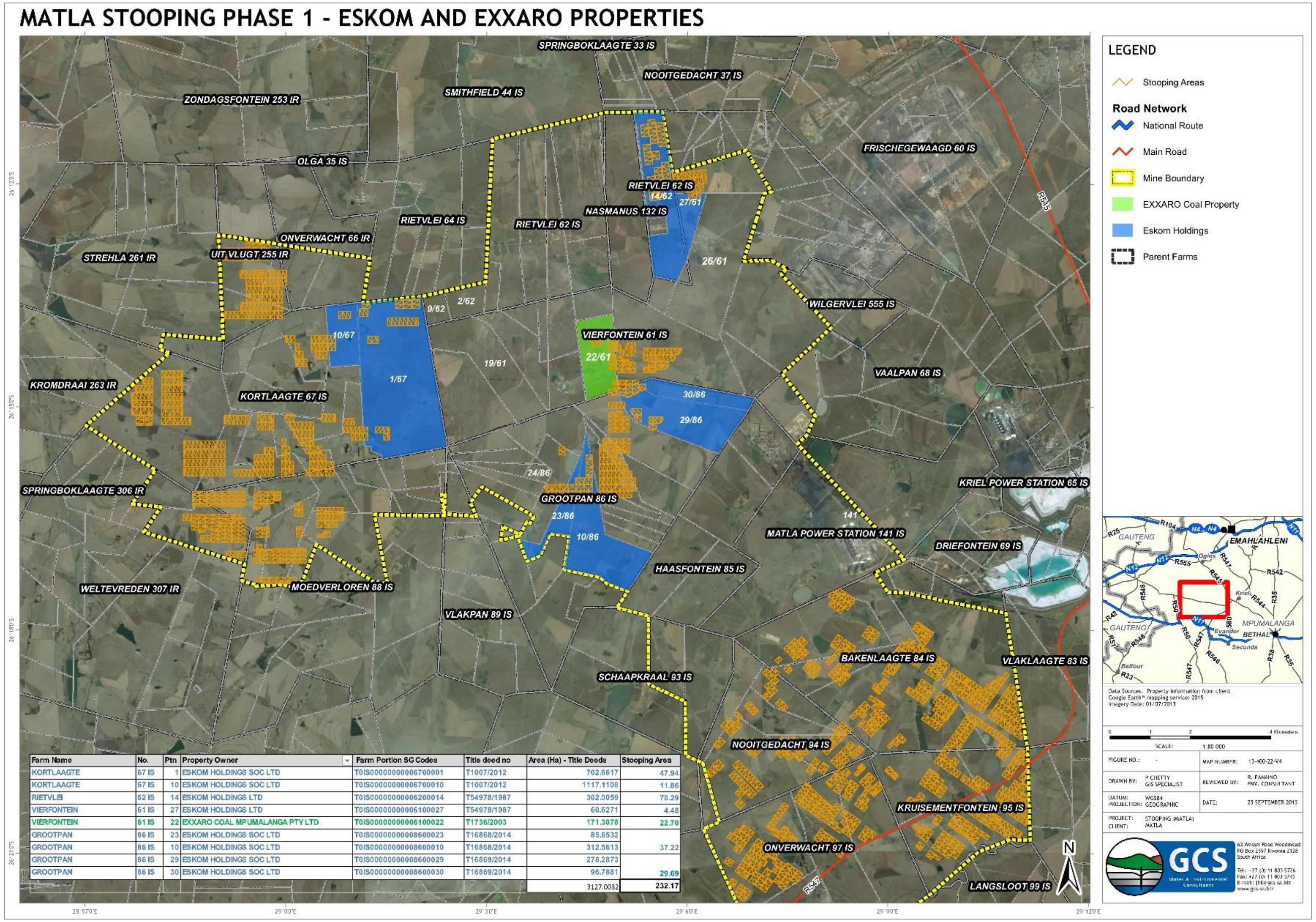
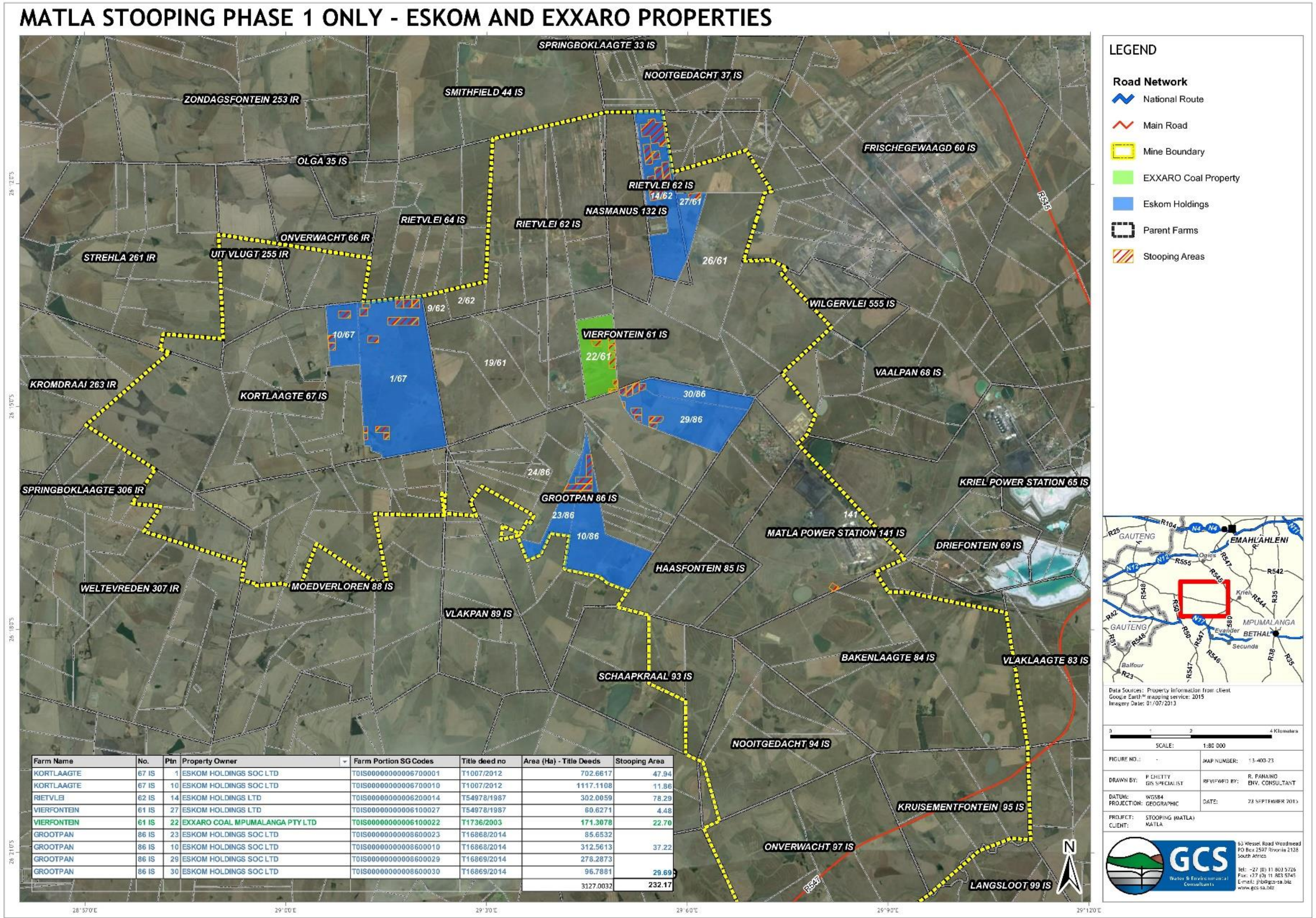


Figure 1-2a – Regional Locality Plan of the Proposed Exxaro Matla Coal Mine Stooping Project



Farm Name	No.	Ptn	Property Owner	Farm Portion SG Codes	Title deed no	Area (Ha) - Title Deeds	Stooping Area
KORTLAAGTE	67 IS	1	ESKOM HOLDINGS SOC LTD	T0IS00000000006700001	T1007/2012	702.6617	47.94
KORTLAAGTE	67 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000006700010	T1007/2012	1117.1108	11.86
RIETVLEI	62 IS	14	ESKOM HOLDINGS LTD	T0IS00000000006200014	T54978/1987	302.0059	78.29
VIERFONTEIN	61 IS	27	ESKOM HOLDINGS LTD	T0IS00000000006100027	T54978/1987	60.6271	4.48
VIERFONTEIN	61 IS	22	EXXARO COAL MPUMALANGA PTY LTD	T0IS00000000006100022	T1736/2003	171.3078	22.70
GROOTPAN	86 IS	23	ESKOM HOLDINGS SOC LTD	T0IS00000000008600023	T16868/2014	85.6532	
GROOTPAN	86 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000008600010	T16868/2014	312.5613	37.22
GROOTPAN	86 IS	29	ESKOM HOLDINGS SOC LTD	T0IS00000000008600029	T16869/2014	278.2873	
GROOTPAN	86 IS	30	ESKOM HOLDINGS SOC LTD	T0IS00000000008600030	T16869/2014	96.7881	29.69
						3127.0032	232.17

Figure 1-2b – Matla Stooping Phase 1 – Eskom and Exxaro Propoerties



Farm Name	No.	Ptn	Property Owner	Farm Portion SG Codes	Title deed no	Area (Ha) - Title Deeds	Stooping Area
KORTLAAGTE	67 IS	1	ESKOM HOLDINGS SOC LTD	T0IS00000000006700001	T1007/2012	702.6617	47.94
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RIETVLEI	62 IS	14	ESKOM HOLDINGS LTD	T0IS00000000006200014	T54978/1987	302.0059	78.29
VIERFONTEIN	61 IS	27	ESKOM HOLDINGS LTD	T0IS00000000006100027	T54978/1987	60.6271	4.48
VIERFONTEIN	61 IS	22	EXXARO COAL MPUMALANGA PTY LTD	T0IS00000000006100022	T1736/2003	171.3078	22.70
GROOTPAN	86 IS	23	ESKOM HOLDINGS SOC LTD	T0IS00000000008600023	T16868/2014	85.6532	
GROOTPAN	86 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000008600010	T16868/2014	312.5613	37.22
GROOTPAN	86 IS	29	ESKOM HOLDINGS SOC LTD	T0IS00000000008600029	T16869/2014	278.2873	
GROOTPAN	86 IS	30	ESKOM HOLDINGS SOC LTD	T0IS00000000008600030	T16869/2014	96.7881	29.69
						3127.0032	232.17

Figure 1-2c – Matla Stooping Phase 1 ONLY – Eskom and Exxaro Propoerties

1.3 Background Information

The size of the Proposed Exxaro Matla Coal Mine's Stooping Project overall mining venture is considered to be large in terms of the volumes of coal that are being planned for mining as well as in terms of the footprint of impact that the activities will have on the surface extent if the effects of subsidence report to surface.

The stooping method of mining that is being proposed for the extraction of the coal pillars from the existing underground sections (Areas A to I – Refer to Figure 1.2b and 1.2c) will optimise the utilisation of the resource and minimise or reduce the need to exploit additional reserves in the near future. Phase 1 of the mining plan considers a much smaller area and confines the stooping activities to the areas owned by Eskom and Exxaro on surface (Refer to Figure 1.2 d and 1-2e).

The proposed plan will help to reduce the overall impact of mining in the area. However, the long term effects of subsidence and the potential for the alteration of the surface topography, the inability for water to drain feely across the landscape, and the consequences of surface cracking and the ponding of water on surface, will all result in long term negative impacts on the soils and ultimately the ecosystem services for the area.

These impacts will also potentially have an effect on the land use (existing surface infrastructure, housing, farm and mine dams, power pylons and transformers, roads, and the associated mine infrastructure), the consequences of which are measurable and understood.

The existing mining activities as well as commercial farming activities within the zone of influence of the proposed development will have an effect on the cumulative impacts. The additional impacts from this proposed project activities are likely to be confined to the immediate area, with the soils being disturbed to stooping activities and the degree of subsidence associated with it.

The geology that hosts the coal resource being targeted is typical of the South African coal fields that occur on the eastern Highveld. The coal planned for mining is associated with layers of carbonaceous rich rock within the sediments of the Vryheid Formation of the Ecca Group and are of Lower Permian age.

The Vryheid Formation consists of sequence of upward fining sediments that comprise predominantly the extremes of coarse and gritty sandstones through fine and medium textured sands to fine grained silty shale's and mudstones with the extremes of structure and pedogenisis that are associated with the semi-arid climate and changes in topography and geology (Refer to Figure 1.3a).

These sediments were deposited on an undulated pre–Karoo floor which had a significant influence on the nature, distribution and thickness of many of the sedimentary formations, including the coal seams. The coal seams are mainly flat lying to gently undulating with a general southerly dip of about 1 in 100. The five classically recognized coal seams are numbered from the base up as No's 1,2,3,4 and 5 respectively and are contained within a 120m succession.

Post-Karoo erosion has removed large parts of the stratigraphic column, including substantial volumes of coal over a wide extent within the project area.

The removal of the pillars from the underground workings will lower the entire stratigraphic sequence above the mined out zone, while the lowering of the surface topography will potentially alter the existing topography and the free draining nature of the landscape with the possibility for ponding of water at surface, resultant soil saturation and the concentration of salts (salinisation) and metals (contamination), and the long term change in the land capability and its ability to contribute to the ecosystem services.

The stooping system of underground mining can disturb the surface features and alter the land capability permanently if the impacts are not recognised and mitigation measures implemented as part of the mining plan. If these issues are not considered, the effects (collapse of underground workings), will be much more difficult and expensive to rectify, both for the soils and ecosystem services associated with the soils, as well as the potential for infiltration of poor quality water (ponding and cracking) from surface to the underlying aquifers.

The sustainability of any project requires that not only a profit is made in terms of the resource mined, but that there is sufficient return of the money made to rehabilitate the disturbed environment at closure.

The soil utilisation plan proposed has been tailored to best achieve these end results in terms of the soils and land capability aspects of this project, with the pre-development conditions having been captured as a record that can be used as part of the "End Land Use" design and planning.

This information (baseline studies) and an understanding of the activities and related impacts will form the basis for the impact assessment and any future management that is needed to mitigate the effects of the mining proposed.

Apart from these issues being required in terms of the law, it is important that the effects of the potential loss of an important resource (soil and land capability) is understood in terms of the sustainability equation and the concept of "No Net Loss".

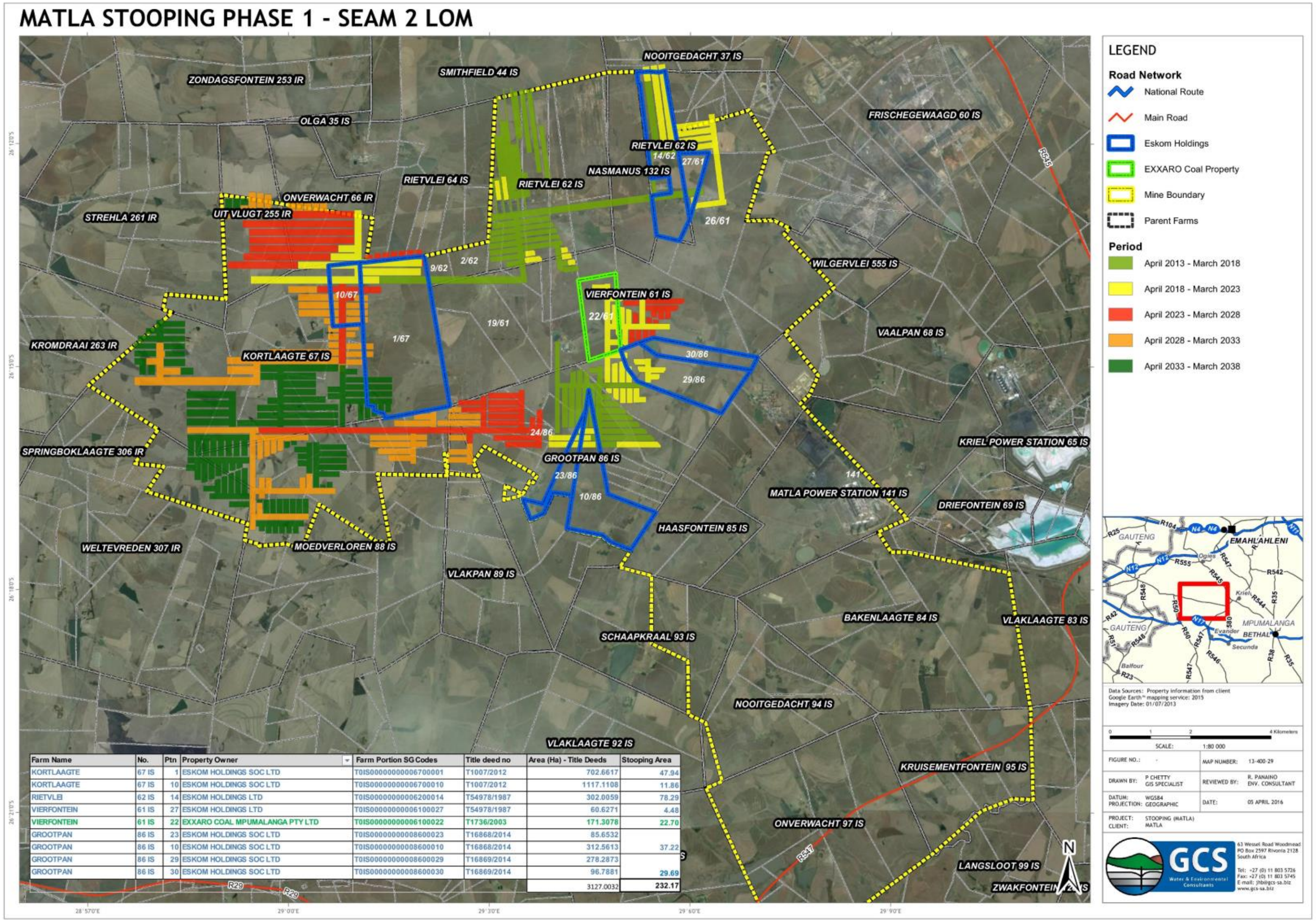
The baseline mapping and characterisation of the soils is the basis from which the impact and effects on the land capability, land use and soils has been measured. In line with these findings, the site specific management planning and mitigation measures for the soils have been defined and detailed. This has included the defining of how the mitigation will reduce the intensity and probability of the impact occurring, and what is necessary to ensure that the prescriptive mitigation proposed is clear, site specific and practical.

In addition, and as part of the soil utilisation and management plan, a comprehensive monitoring system has been proposed and tabled.

The Proposed Exxaro Matla Coal Mine Stooping Project is part of the strategic development required in terms of energy production in South Africa, and although this is not a new development, it is part of the optimisation and extension to the life of the Eskom Matla Power Station.

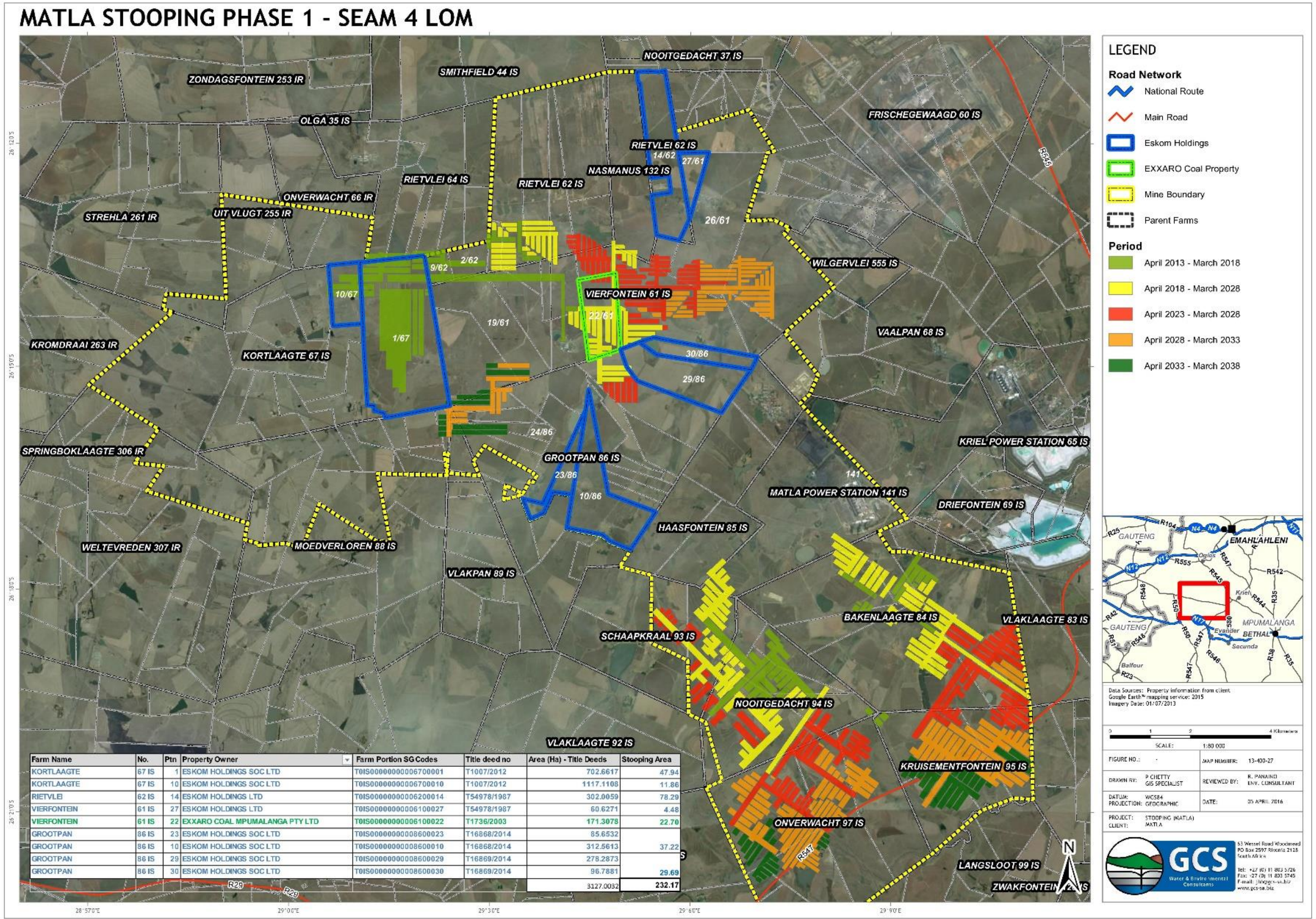
The lead consultants (GCS) contracted Earth Science Solutions (Pty) Ltd (ESS) to assist with the specialist soils, land use and land capability sections of the baseline studies, the assessment of impacts and the development of a soil utilisation and management plan to assist in the minimisation and mitigation for the life of the mining venture, through the operation to post closure (operation and closure).

Figure 1-2a and 1-2b shows the location of the Exxaro Matla Coal mine mining right area and the location of the Proposed Stooping Project on properties owned by Eskom and Exxaro Coal Mpumalanga (Pty) Ltd. while Figure 1-2b delineates the overall stooping mine plan, and 1.2c the areas to be considered as part of Phase 1 of the mine plan.



Farm Name	No.	Ptn	Property Owner	Farm Portion SG Codes	Title deed no	Area (Ha) - Title Deeds	Stooping Area
KORTLAAGTE	67 IS	1	ESKOM HOLDINGS SOC LTD	T0IS00000000006700001	T1007/2012	702.6617	47.94
KORTLAAGTE	67 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000006700010	T1007/2012	1117.1108	11.86
RIETVLEI	62 IS	14	ESKOM HOLDINGS LTD	T0IS00000000006200014	T54978/1987	302.0059	78.29
VIERFONTEIN	61 IS	27	ESKOM HOLDINGS LTD	T0IS00000000006100027	T54978/1987	60.6271	4.48
VIERFONTEIN	61 IS	22	EXXARO COAL MPUMALANGA PTY LTD	T0IS00000000006100022	T1736/2003	171.3078	22.70
GROOTPAN	86 IS	23	ESKOM HOLDINGS SOC LTD	T0IS00000000008600023	T16868/2014	85.6532	
GROOTPAN	86 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000008600010	T16868/2014	312.5613	37.22
GROOTPAN	86 IS	29	ESKOM HOLDINGS SOC LTD	T0IS00000000008600029	T16869/2014	278.2873	
GROOTPAN	86 IS	30	ESKOM HOLDINGS SOC LTD	T0IS00000000008600030	T16869/2014	96.7881	29.69
						3127.0032	232.17

Figure 1-2d – Matla Stooping Mine Plan – Phase 1 Seam 2 LOM



Farm Name	No.	Ptn	Property Owner	Farm Portion SG Codes	Title deed no	Area (Ha) - Title Deeds	Stooping Area
KORTLAAGTE	67 IS	1	ESKOM HOLDINGS SOC LTD	T0IS00000000006700001	T1007/2012	702.6617	47.94
KORTLAAGTE	67 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000006700010	T1007/2012	1117.1108	11.86
RIETVLEI	62 IS	14	ESKOM HOLDINGS LTD	T0IS00000000006200014	T54978/1987	302.0059	78.29
VIERFONTEIN	61 IS	27	ESKOM HOLDINGS LTD	T0IS00000000006100027	T54978/1987	60.6271	4.48
VIERFONTEIN	61 IS	22	EXXARO COAL MPUMALANGA PTY LTD	T0IS00000000006100022	T1736/2003	171.3078	22.70
GROOTPAN	86 IS	23	ESKOM HOLDINGS SOC LTD	T0IS00000000008600023	T16868/2014	85.6532	
GROOTPAN	86 IS	10	ESKOM HOLDINGS SOC LTD	T0IS00000000008600010	T16868/2014	312.5613	37.22
GROOTPAN	86 IS	29	ESKOM HOLDINGS SOC LTD	T0IS00000000008600029	T16869/2014	278.2873	
GROOTPAN	86 IS	30	ESKOM HOLDINGS SOC LTD	T0IS00000000008600030	T16869/2014	96.7881	29.69
						3127.0032	232.17

Figure 1-2d – Matla Stooping Mine Plan – Phase 1 Seam 4 LOM

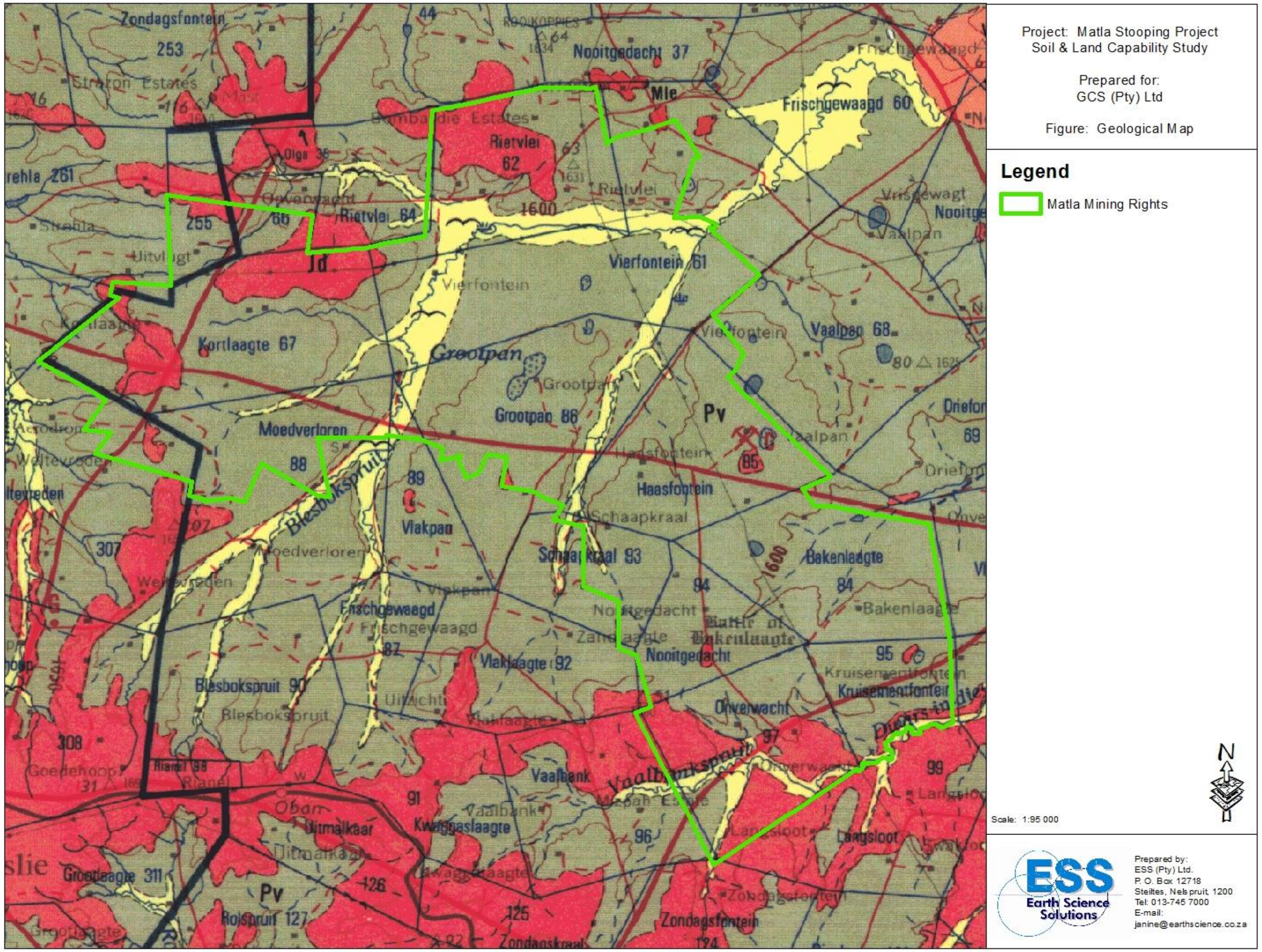


Figure 1-3a – Geological Map of the Exxaro Matla Coal Mine Stooping Project within the approved mining right boundaries

The soils, land use and land capability are just three of the specialist disciplines that have been considered important to the physical environment, and which will be affected by the activities being proposed.

In the planning of any new development it is important that the impacts are understood prior to the initiation of the design and/or implementation of the project.

These environmental aspects are not least of all part of the information that is needed in this decision making, with an understanding of how the soils, land use and the land capability will be affected being just part of the overall sustainability equation that needs to be answered and balanced.

The results of the soils and land capability study have been discussed in terms of the “dominant soils” and their “sensitivity”, with the soils mapping having been simplified based on the similarities in the soil forms (physical and chemical characteristics), their functionality and their associated land capability. In this way, the sustainability of the project can be measured in terms of the impacts and related mitigation, with sensitive areas being managed in a sound scientifically derived manner.

A comprehensive soil utilisation plan is tabled as part of the Environmental Management Planning and describes how the soils should be managed if the impacts are to be minimised.

The principle or concept of “No Net Loss” (NNL) has been tabled as the ultimate aim in developing a project to be sustainable. However, the mining of coal by underground bord and pillar and stooping methods will definitely challenge the concept of No Net Loss.

The activities will potentially have a varying negative impact on the natural resources for a significant period of time, and the present land uses (soils) and land capabilities will definitely be altered and impacted for the life of the proposed operations and possibly even beyond.

1.4 Methodology and Approach

An evaluation at a desktop level (scoping study) of the geomorphology of the area (topography, geology, geohydrology and hydrogeology) indicated that all of the specialist earth sciences would be necessary if a sustainable solution was to be found for the many aspects of change that could affect the area due to a project of the size and duration of the Proposed Exxaro Matla Coal Mine Stooping Project.

The Soils, Land use and Land Capability studies are but three of the specialist studies that have been considered as important to the development of the sustainability plan.

The relative density of survey coverage proposed for the soils and land capability baseline studies was tailored so as to obtain sufficient scientifically derived information that a statistically reliable data set was assimilated and captured, that could be utilised in the assessment of impacts and the design of a meaningful management plan for mitigation and minimisation. These studies are not intended, and must not be used for engineering designs other than the soil utilisation and rehabilitation planning. Detailed geotechnical evaluations for materials sourcing are essential for any engineering purposes and will have to be assessed and detailed as part of the geotechnical and engineering design.

The soil, land use and land capability specialist studies have been tailored to the site specifics, and are developed as the basis for the characterisation and classification of the soils and the rating of the land capability. The mine plan has been used as the basis for the activities being planned.

These norms are based on a specific set of principles as set down in the "Taxonomic Soil Classification, a system designed for South Africa" (described in detail later). These norms are consistent with the NEMA Regulations, World Bank Standards and national nomenclature.

The resultant physical and chemical characteristics of the materials are used to characterise and highlight the site specific sensitivities which are then combined into dominant soils "groupings".

These groups have similar physical and chemical characteristics for which the possible impacts predicted will have similar effects, and for which the same mitigation and management measures can be applied for any given activity.

This simplification of the soil forms can be used by the developer more easily and with better results as part of the planning and decision making tools (Not for design purposes). In addition, the stakeholders or affected parties (Public and Authorities) can make informed and scientifically based decisions on the relative sustainability of the project for the soils and land capability using a more understandable explanation.

In better understanding and informing these studies on how sensitive or vulnerable a soil is, it is essential that the system being used is able to establish and measure in a repeatable manner, the aspects and determinants that contribute to a material being robust or sensitive.

The Soil Classification System and Land Capability Rating Systems supply the scientific basis and knowledge needed to determine the sensitivity or vulnerability of the different actions being proposed.

The soils' physical and chemical properties and the way in which these react to the elements (wind, water erosion, heat, chemical reaction etc.), the sensitivity to having the vegetative cover removed, or their vulnerability to having the topsoil disturbed, and the reaction of the materials to chemical impacts (ease of being taken into solution), are all aspects that have been assessed in measuring sensitivity and ultimately vulnerability to development.

These measures are important when considering the impact assessment, and will dictate the mitigation and management measures (degree of input etc.) that will be required.

Using this philosophy the study area was investigated on a comprehensive reconnaissance grid base and an assessment and understanding of the baseline conditions for the soils and land capability obtained.

The level of study and intensity (spatial variance) of the observations made was guided by a number of practical variables. These included the geomorphology of the site (topography, ground roughness, altitude and climate) and knowledge of the proposed development (mine plan) and the actions that are intended.

Very little detailed soils information was available from any of the regional assessments. Although the Land Type Maps (Government) and Geological Maps were of help in understanding the proposed planning for the area and the high level understanding of the agricultural potential, land capability and associated earth sciences variables; the sensitivities and site specific variations and aspects that are important to the ecological balance of the area of study were lacking.

1.5 Legal Considerations

As part of understanding the consequences of the proposed development, knowledge of the pertinent legislation is important, and is a guide in understanding the permissible standards and limits that can be considered, albeit that there are no prescribed quantitative limits quoted.

The most recent South African Environmental Legislation considered for soils and soil management includes:

- The Conservation of Agricultural Resources Act (CARA) (No. 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.
- The Bill of Rights (Chapter 2) states that environmental rights exist primarily to ensure good health and wellbeing, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources.
- The Environmental right is furthered in the National Environmental Management Act (No. 107 of 1998) (NEMA), which prescribes three principles, namely the precautionary principle, the “polluter pays” principle and the preventive principle. It is a stated requirement, that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted and/or disturbed source/areas.
- Soils and land capability are protected under NEMA, the MPRDA and CARA.
- NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and remedied.
- The MPRDA requires an EMP Report (EMPR), in which the soils and land capability be described.
- CARA requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and water courses are also addressed.

In addition to the South African legal compliance, the International Finance Corporations (IFC) international performance standards have been considered as a basis and guideline of principles for best practice.

The IFC has developed a series of Performance Standards to assist developers and potential clients in assessing the environmental and social risks associated with a project and assisting the client in identifying and defining roles and responsibilities regarding the management of risk.

Performance Standard 1 establishes the importance of:

- Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;
- Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and
- The client’s management of social and environmental performance throughout the life of the project.

Performance Standards 2 through 8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate.

While all relevant social and environmental risks and potential impacts should be considered as part of the assessment, Performance Standards 2 through 8 describe potential social and environmental impacts that require particular attention in emerging markets. Where social or environmental impacts are anticipated, the client is required to manage them through its Social and Environmental Management System consistent with Performance Standard 1.

Of importance to this report are:

- The requirements to collect adequate baseline data;
- The requirements of an impact/risk assessment;
- The requirements of a management program;
- The requirements of a monitoring program; and most importantly;
- To apply relevant standards (either host country or other).

With regard to the application of relevant standards, there are no specific quantitative guidelines relating to soils and land use/capability, either locally or within the World Bank's or IFC's suite of Environmental Health and Safety Guidelines. However, the World Bank's Mining and Milling guideline does state that project sponsors are required to prepare and implement an erosion and sediment control plan.

The plan should include measures appropriate to the situation to intercept, divert, or otherwise reduce the storm water runoff from exposed soil surfaces, tailings dams, and waste rock dumps.

Project sponsors are encouraged to integrate vegetative and non-vegetative soil stabilization measures in the erosion control plan.

Sediment control structures (e.g., detention/retention basins) should be installed to treat surface runoff prior to discharge to surface water bodies. All erosion control and sediment containment facilities must receive proper maintenance during their design life.

This will be included in the appropriate management plans where they are developed as part of the detailed design and as part of the project's life cycle.

1.6 Assumptions, Limitations and Uncertainties

It has been assumed that the total area of possible disturbance was included in the area of study (no go areas and sites of no access have been excluded), that the mining plan as tabled has documented and catered for all actions and activities that could potentially have an impact on the soils, land use and land capability, and that the recommendations made and impact ratings tabled will be re-assessed if the development plan changes.

Limitations to the accuracy of the pedological mapping (as recognised within the pedological industry) are accepted at between 50% (reconnaissance mapping) and 80% (detailed mapping), while the degree of certainty for the soils physical and chemical (analytical data) results has been based on **"composite"** samples taken from the dominant soil types mapped in the study area.

The area in question has been mapped on a comprehensive reconnaissance base, the intensity of mapping and geochemical sampling being considered and measured based on the complexity of the soils, the site specifics of the geomorphological aspects (ground roughness, slope, aspect and geology etc.) and a knowledge of the potential impacts that the mining activities being proposed could have on the physical and socio economics of the environment.

2. DESCRIPTION OF THE PRE-CONSTRUCTION ENVIRONMENT

2.1 Data Collection and Gap Analysis

2.1.1 Review of Available Information

The specialist soils, land use and land capability studies have been undertaken using a phased approach, with the baseline assessment being undertaken during August and September 2014, while the impact and management plan is based on the baseline of information gathered, mine plan and project description made available by the lead consultants. The mapping was based on the most recent mining plan that was made available through the lead consultants.

The site specific nature of the resource (coal seams are fixed in space) and the spatial distribution of the mining activities renders the impact as “site specific” or “Local”, and only the alternatives with regard to the haulage of the materials and the position of the entrance to the underground workings could be considered in terms of alternatives if the existing infrastructure is not adequate.

In addition, the “no-mining” option is a consideration that has been taken into account.

Site sensitivities and possible “No Go” considerations have been highlighted wherever pertinent, with specific regard/emphasis being given to areas of wetness, shallowness of rooting depth, soil erosion and compaction and the effects of solution weathering. When considering the effects that mining will have on the surface attributes and ecosystem services, the soils and land capability are the most likely aspects that will affected, changed and possibly lost from the system, with a resultant reduction in resource availability.

The site specific sensitivities have been highlighted and used in the delineation of environmentally sensitive “No Go” or “High Sensitivity” areas. These considerations are recognised as important in the process of sustainable development and the obtaining of scientific information that is useful in addressing the stakeholders concerns.

In line with the understanding that mining and development will “change” with time, the need for these studies to be acknowledged as living documents is recognised, with the possibility existing for the introduction of additional activities or infrastructure and changes to the mining plan over time a reality. It is therefore important that the baseline study was comprehensive enough, and could be utilised by the developer for site selection, and the development of a feasible plan as part of the Exxaro Matla Coal Mine Stooping Project planning.

The determination of a best alternative site plan for any new development is part of any sustainability plan and should be available to the design and planning team so that the best decisions can be considered early in the projects life. Again it is emphasised that the soils study must not be used for engineering design purpose and strength of materials considerations, but should be part of the environmental and socio economic strategy.

The physical properties are considered in terms of soil structure and texture, while the chemistry is also considered as part of the assessment (no engineering properties are implied or considered as part of these studies). However, the possible depths for stripping purposes and the workability of the soils can be determined and utilised from the information documented.

The government survey maps (geological and topocadastral) and the regional descriptions were used in obtaining an understanding of the general lithological setting for the area, while discussions with the farming community helped in understanding the possible pedogenic processes that could be unique to the specific environment. However, the scale of this information is insufficient for the level of data needed for a project of this magnitude.

2.1.2 Field Assessments

A reconnaissance pedological study of the total area delineated by the client was undertaken using a comprehensive grid base/scale of mapping. The degree of coverage has been based on the assumption that the underground mining system (stooping) will potentially have an negative impact on the surface conditions due to the collapse of the hanging wall and resultant subsidence.

The amount of subsidence, its spatial distribution and resultant impact will need to be mapped using the geological and geotechnical information (detailed strength of materials and *in-situ* testing). Collapse of ground at surface due to any subsidence underground will result in surface cracks and the loss of surface runoff into the groundwater zone, while ponding will occur due to the interference on surface drainage and the ability of surface water to runoff freely. This will in turn result in the degradation of the vadose zone and soils, loss of land capability, land utilisation potential, and the potential for sterilisation of the soils. These conditions are something that is extremely difficult to mitigate, and will impact the overall ecosystem services negatively.

The effects of underground stooping of the coal pillars will result in the modification of the surface topography and result in changes to the landscape (lowering of the land surface). These activities will, if not well managed and engineered as part of the mine planning, result in changes to the hydrological flow patterns on surface and potentially cause “ponding” and ingress of water at surface due to forming of surface cracks.

Ponding of surface water and the un-managed increase in infiltration of surface water into the vadose zone through surface cracks that might form due to subsidence will have significant negative implications for the utilisation potential and land capability of the area, and result in high negative impacts that are costly and difficult to mend. The management and mitigation of sub-surface collapse are covered in the soil utilisation and management plan.

2.1.3 Field Methodology

In addition to the grid point observations, a representative selection of the soil forms mapped were sampled and analysed to determine their chemistry and physical attributes. The soil mapping was undertaken on a 1:10,000 scale (Refer to Figure 2.1.2b – Dominant Soils and Appendix 1 for Area Specific Dominant Soils Maps) orthophotographic base.

The majority of observations used to classify the soils were made using a hand operated bucket auger and Dutch (clay) auger.

Standard mapping procedures and field equipment were used throughout the survey.

The fieldwork comprised a number of site visits during which profiles of the soil were examined and observations made of the differing soil extremes.

Relevant geomorphological information relating to the climate, geology, terrain morphology and wetland environmental parameters were also considered at this stage, and used in the classification of the soils of the area, while the variation in the natural vegetation where present was also used to help in mapping the dominant soil units.

The pedological study was aimed at investigating/logging and classifying the soils within the area of potential disturbance.

Terrain information, topography and any other infield data of significance was also recorded, with the objective of identifying and classifying the area in terms of:

- The soil types to be disturbed/rehabilitated;
- The soil physical and chemical properties;
- The soil depth;
- The erodibility of the soils;
- Pre-construction soil utilisation potential; and
- The soil nutrient status.

2.1.4 Soil Profile Identification and Description Procedure

The identification and classification of soil profiles were carried out using the *Taxonomic Soil Classification, a System for South Africa (Mac Vicar et. al, 1991*)

The Taxonomic Soil Classification System is in essence a very simple system that employs two main categories or levels of classes, an upper level or general level containing Soil Forms, and a lower, more specific level containing Soil Families.

Each of the soil Forms in the classification is a class at the upper level, defined by a unique vertical sequence of diagnostic horizons and materials.

All soil forms are subdivided into two or more families, which have in common the properties of the Form, but are differentiated within the Form on the basis of their defined properties.

In this way, standardised soil identification and communication is allowed by use of the names and numbers given to both Form and Family.

The procedure adopted in field when classifying the soil profiles is as follows:

- Demarcate master horizons;
- Identify applicable diagnostic horizons by visually noting the physical properties:
  - ✓ Depth (below surface);
  - ✓ Texture (Grain size, roundness etc.);
  - ✓ Structure (Controlling clay types);
  - ✓ Mottling (Alterations due to continued exposure to wetness);
  - ✓ Visible pores (Spacing and packing of peds);
  - ✓ Concretions (cohesion of minerals and/or peds);
  - ✓ Compaction (from surface).
- Determine from i) and ii) the appropriate Soil Form;
- Establish provisionally the most likely Soil Family.

Table 2.1.4 Explanation - Arrangement of Master Horizons in Soil Profile

<table>
<tr><td rowspan="11">SOLUM</td><td rowspan="11">(Zone in which the soil forming processes are maximally expressed)</td><th colspan="5">Arrangement of master horizons</th><th>Comments on Layers</th></tr>
<tr><td rowspan="10">O - Organic</td><td rowspan="5">C - Regic Sands (C), Stratified Alluvium (C), Man - Made Soil Deposits (C).</td><td rowspan="2">A</td><td rowspan="2">Humic,Vertic, Melanic, Orthic</td><td rowspan="10">G</td><td>Loose leaves and organic debris, largely undecomposed</td></tr>
<tr><td>Organic debris, partially decomposed or matted</td></tr>
<tr><td rowspan="3">B</td><td rowspan="3">Red Apedel, Yellow-brown Apedel, Soft Plinthic, Hard Plinthic, Prismacutanic, Pedocutanic, Lithocutanic, Neocutanic, Neocarbonate, Podzol, Podzol with placic pan</td><td>Dark coloured due to admixture of humified organic matter with the mineral fraction</td></tr>
<tr><td>Light coloured mineral horizon</td></tr>
<tr><td>Transitional to B but more like A than B</td></tr>
<tr><td rowspan="4">C</td><td colspan="2" rowspan="4">Dorbank, Soft Carbonate horizon, Hard Carbonate Horizon, Saprolite, Unconsolidated materials without signs of wetness, Unconsolidated materials with signs of wetness, Unspecified materials with signs of wetness</td><td>Transitional to A but more like B than A</td></tr>
<tr><td>Maximum expression of B-horizon character</td></tr>
<tr><td>Transitional to C</td></tr>
<tr><td>Unconsolidated material</td></tr>
<tr><td colspan="3">R - Hard Rock</td><td>Hard rock</td></tr>
</table>

2.1.5 Sample Analysis

Sampling of representative soils was carried out and submitted for analysis.

Factors that were considered in the laboratory included:

- Determination of the pH;
- Exchangeable bases;
- C.E.C. (cation exchange capacity);
- Texture (% clay);
- Nutrient status; and
- Any potential pollutants.

The methods employed in the determination of the above variables are:

- The Spectro Atomic Analyser for the determination of the basic elements;
- The titration method for the determination of Organic Carbon contents; and
- The use of a density meter for the determination of the clay contents.

Analytical results are given for the extractable quantities available from the soil (Refer to Tables 2.1.7.1).

2.1.6 Description

Soil Characterisation

The soils encountered can be broadly categorised into four major groupings, with a number of dominant and sub dominant forms that characterise the area of concern (Refer to Figure 2.1.6b).

The major soil forms are closely associated with the lithologies from which the soils are derived (*in-situ* formation) as well as the topography and general geomorphology of the site, with the effects of slope and altitude of the land forms and the pedogenetic processes involved, affecting the soil formation and ultimately the soil forms mapped.

The generally flat to slightly undulating topography has resulted in the *in-situ* formation of many of the soils, and a moderately predictable pedogenisis for the site, albeit that the retention of soil water within the vadose zone (lack of preferred horizontal flow) has resulted in the creation of an inhibiting layer (calcrete/ferricrete) within some of the soil profile.

This inhibiting layer or barrier to water movement enhances the inhibiting character to vertical flow within the profile, a factor that is considered important to the ecology and biodiversity of the area.

It is hypothesised that the ferricrete layer that is found associated with the shallow iron rich and horizontally bedded sediments, is responsible for the restrictive layer that is holding water within the soil profile and resulting in the development of moderately extensive areas of wet based soils and evaporites.

The occurrence of calcrete and/or ferricrete horizons within the soil profile classify as “relic” land forms for the most part, albeit that significant area of more recent laterite development was mapped in association with the lower lying river floodplains and alluvial environs.

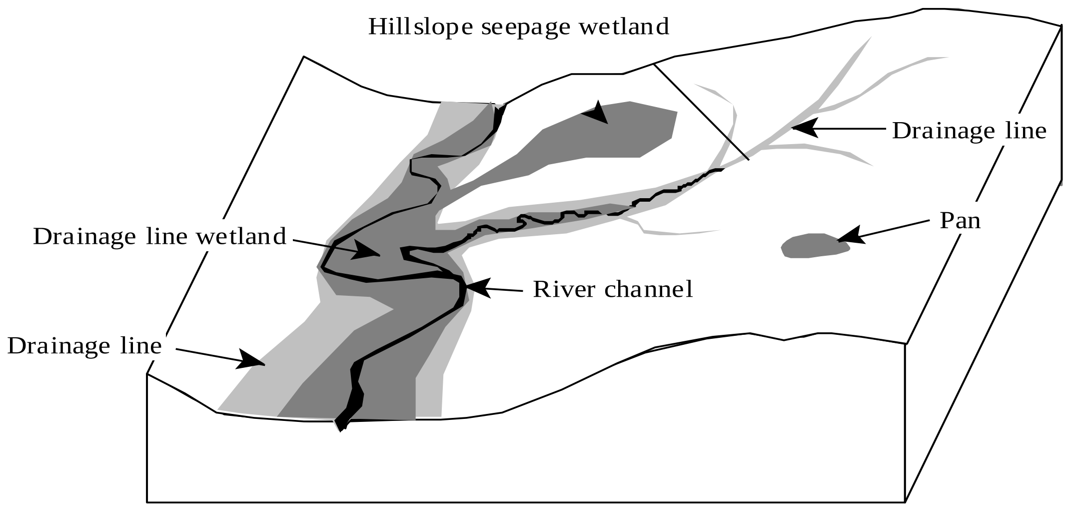


Figure 2.1.6aSchematic of the Wetlands and their relation to Topography

The relic land forms are commonly associated with hillside seeps and "sponge zones" (Refer to Figure 2.1.6a), both of which are associated with possible wetland development. These ferricrete layers occasionally outcrop at surface as "ouklip" or hardpan ferricrete/laterites and are the basis for some of the pan structures found within the sedimentary profile and landscape that typifies the coalfields in this region.

These features are important to the ecological and biodiversity cycle, and are regarded as sensitive to highly sensitive features. In addition, and as part of these sensitive systems, are the "transition zones" often associated with the deeper sandy loams, and which store and transmit the soil water to the wetlands. These soils are in essence the catchment system for the wetlands, and as such are considered sites of significance and potentially areas of high sensitivity.

The dominant soils classified are described in terms of their physical and chemical similarities and to some extent their topographic position and resultant pedogenisis. Their spatial distribution is of importance to the management recommendations and overall mitigation strategy (Refer to Figure 2.1.6b – Dominant Soils and Appendix 1 for Detailed Soils Maps for each Area – A to I). The major soil groupings are described in more detail later in this section.

The soils mapped range from shallow sub-outcrop and outcrop of hard plinthite and parent materials (Sediments and intrusive dolerite) to moderately deep sandy loams and sandy clay loams, all of which are associated with either a hard rock base to the "C" horizon, a thin saprolitic layer (weathering rock) or ferricrete/laterite at differing depths. The saprolitic horizons are generally quite thin, with soil occurring on hard bedrock in most instances mapped.

When considering the sensitivity of a soil, the overall rooting depth, depth to wetness, or an inhibiting layer (physical or chemical) and the amount of redox reaction present (noted in the degree of mottling and more importantly the greyness of the matrix soil) are considered important, while the texture and structure of the soil are also noted. The sensitivity of wetlands is important and is a consideration legislated in terms of the DWS and the "wetland delineation classification" due mainly to the important contributions that wetlands have for the ecological status and biodiversity of an area. These translate into sensitivity and potential vulnerability when disturbed.

The shallow, to very shallow soil profiles are generally associated with an inhibiting layer at or close to surface, and as already alluded to, are some of the defining feature that controls the ability, or not, of water to move vertically down and through the profile (restrictive layer).

The degree to which the plinthite layer has been cemented (friability of the ferricrete) will determine the effectiveness of the layer as a barrier to infiltration, while the depth of overlying soil will dictate how easily or difficult it is for the soil water to be accessed by the fauna and flora, and in the extreme case whether water is held at surface as a pan.

The friability of the ferricrete will also have an effect on the amount of clay mineralisation that the soil contains within this horizon, and will in turn influence the water holding characteristics of the soil and the degree of structure. In addition to the soil system of classification, a specific system has been developed for the describing and classification of ferricrete (Refer to Appendix 2). This has been used in better understanding the resultant land forms mapped.

In contrast, the deeper and more sandy profiles, although associated with a similar lithological system, have distinctly differing pedogenetic processes that are associated with lower clay contents, better drainage of the soils and a deeper weathering profile

As with any natural system, the transition from one system to another is often complex with multiple facets and variations over relatively small/short distances.

However, in simplifying the trends mapped, the following major soil groupings have been grouped into a number of dominant groupings.

These include:

- The **deeper and more sandy loam** soils are considered soils/materials with high potential in terms of their ecosystem services and are distinguished by their better than average depth of relatively free draining soil (> 1,200mm).

  This group is recognisable by the lack of any wetness indicators or, where present the subtleness of the mottling (water within the profile for less than 30% of the season), and their occurrence at depths of greater depths within the profile (>500mm) and the land capability is rated as moderate intensity grazing and/or arable depending on their production potential.

  These soils are generally significantly lower in clay than the associated wet based soils and more structured colluvial derived materials, have a distinctly weaker structure and are deeper and better drained (better permeability). The ability for water to permeate through these profiles is significantly better.

  The more sandy texture of this soil group renders them more easily worked and renders them of a lower sensitivity (Deep >500mm).

- In contrast, the shallower and more structured materials are considered to be more ***sensitive*** and will require greater management if disturbed. This group of ***shallower and more sensitive soils*** (< 500mm) are associated almost exclusively with the sub outcropping of the parent materials (Karoo Sediments) (geology) at surface, and although they constitute a relatively small percentage of the overall area of study they have a significantly large and important function in the sustainability of the overall biodiversity of the area.
- The third group comprise those that are associated with the hard pan ferricrete layer and perched soil water ***(wet based soils)***. This group of soils has a set of distinctive characteristics and nature that are separated out due to their inherently much more difficult management characteristics. These soils are characterised by relatively much higher clay contents (often of a swelling nature), poor intake rates, poor drainage, generally poor liberation of soil water and a restricted depth – often due to the inhibiting barrier within the top 700mm of the soil profile. These soils are generally associated with a wet base.

  These soils will be more difficult to, work in the wet state, store, and re-instate at closure. These soils are associated with the pan structures and natural occurring waterholes. Groundwater is generally relatively deep (>15m) for the majority of the area of study and is reported (hydrogeologists) to have little to no influence on the soil water and water found within the vadose zone.

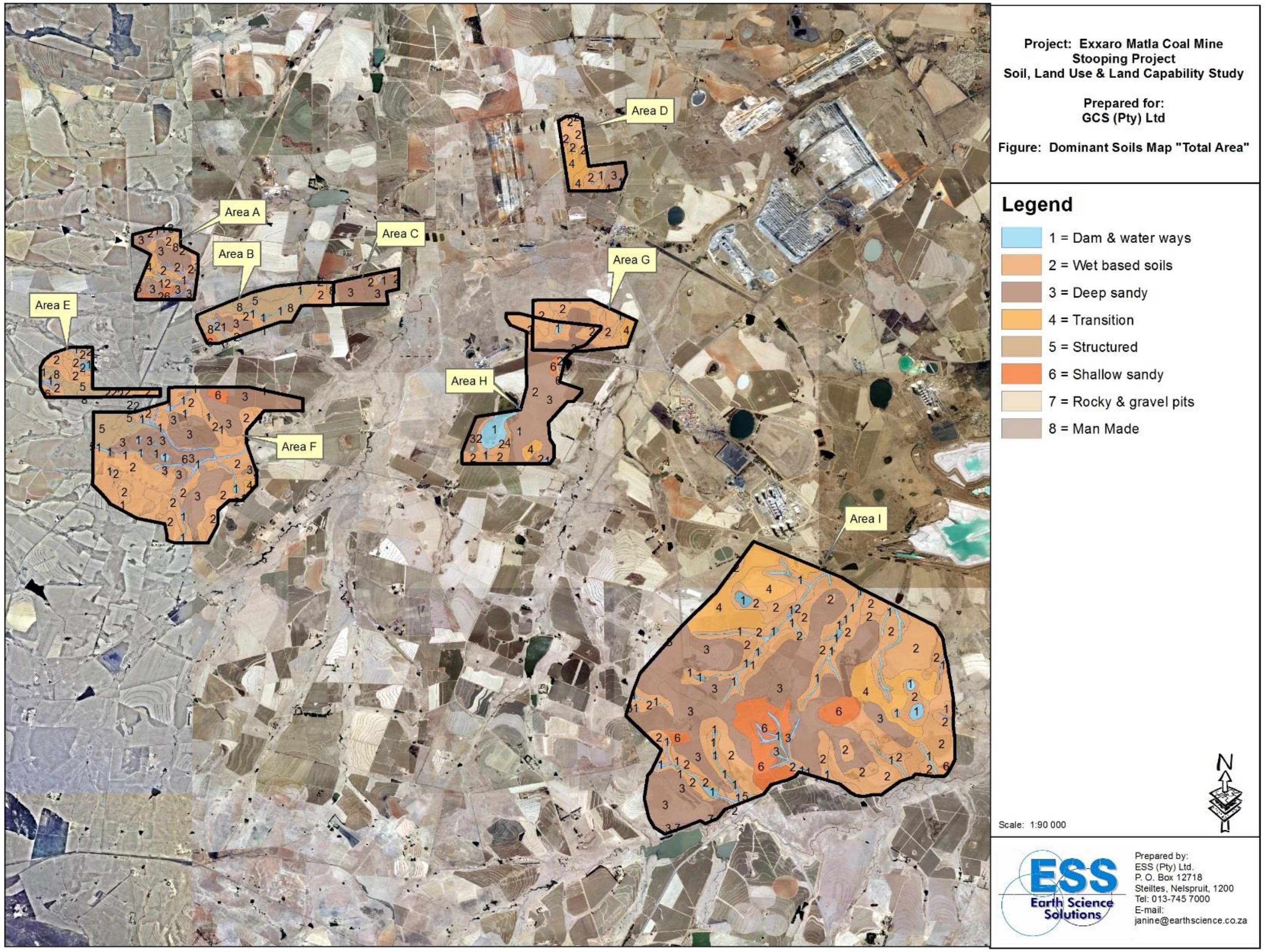


Figure 2.1.6b **Soil Map indicating the dominant soils types as identified with the Exxaro Matla Coal Mine's proposed Stooping Project areas (Areas A-I)**

No perched aquifers (groundwater) are reported, albeit that a significant area of well-developed ferricrete was mapped within the vadose zone on a number of the areas mapped. The development of wet based soils and moist grassland environments are mapped in association with these soil forms.

Again, it is noted as important to the baseline study, that these soil groupings are moderately extensive in spatial area, and cover a moderately large and sensitive area in terms of the proposed development/mining plan.

In addition, but not separated from the wet based structured soils, are the group of materials that reflect ***wetness*** (wet based soils) within the top 500mm. These soils are easily recognised by the mottled red and yellow colours that occur on low chroma background to the soil. These soils are regarded as ***highly sensitive***, and areas that will require authorisation/permission if they are to be impacted. The legal implications (licensing) will need to be considered if these soils are to be considered within the zone of development.

The concentrations of natural salts and stores of nutrients within these soils are again a sensitive balance due to the extremes of rainfall, wind and temperature. The ability of a soil to retain moisture and nutrients, and in turn influence the sustainability of vegetative growth and dependence of animal life, is determined by the consistency and degree of soil moisture retention within the profile, but out of the influence of evaporation.

These conditions and associated sensitivities should be noted in terms of the overall bio-diversity balance if the sustainability equation is to be managed and mitigation engineered. Pan structures and the associated shallow wet based soils is an important contributor to the ecological cycle.

All areas included in the study have been captured in a GIS format and mapped according to their soil classification nomenclature and soil depth (decimetres), while similar soil forms have been grouped and mapped as dominant groupings for ease of management.

2.1.7 Soil Chemical and Physical Characteristics

A suite of representative samples from the differing soil forms were taken and sent for analyses for both chemical and physical parameters (Refer to Table 2.1.7.1). A select number of samples were submitted, each sample containing a number of sub samples from a particular soil Form which is representative of the area in question. Each sample comprises a "composite sample", and is representative of the Soil Form rather than a specific point sampled.

2.1.7.1 Soil Chemical Characteristics

Sampling of the soils for nutrient status was confined where possible to areas of undisturbed land. However, some of the better soil exposure is associated with land that has, or could have been disturbed by farming activities. These results are representative indications of the pre-construction conditions. However, these results are at best a reconnaissance representation of the baseline conditions and will need to be verified for particular sites as and when rehabilitation is started.

On-going sampling and monitoring of the *in-situ* conditions will be necessary throughout the operational phase to accurately define the post-operational conditions if the rehabilitation is to be successful.

The results of the laboratory analysis returned a variety of materials that range from very well sorted sandy loams with lower than average nutrient stores and moderate clay percentages (<20% - B2/1), to soils with a moderately stratified to weak blocky structure, sandy loam to clay loam texture and varying degrees of utilisable nutrients on the colluvial derived materials, while high clays and extremes of structure are associated with the wet based and wetland soils that dominate the alluvial derived and bottom land floodplain wetlands.

In general, the pH ranges from slightly acidic at around 5.5 to neutral and slightly alkaline at 7.5, a base status ranging from 3me% to 7me% (Eutrophic (slight leaching status) to Mesotrophic (moderate leaching status)), and nutrient levels reflecting generally high levels of calcium and sodium, but deficiencies in the levels of magnesium, potassium, phosphorous, copper, aluminium and zinc, with low to very low stores of organic carbon matter.

The more structured (moderate blocky) and associated sandy and silty clay loams returned values that are indicative of the more iron rich materials and more basic lithologies that have contributed to the soils mapped. They are inherently low in potassium reserves, and returned lower levels of zinc and phosphorous.

The growth potential on soils with these nutrient characteristics is at best moderate to poor and additions of nutrient and compost are necessary if commercial returns are to be achieved from these soils. They are at best moderate to good grazing lands.

Soil fertility

The soils mapped returned, at best, moderate levels of some of the essential nutrients required for plant growth, with sufficient stores of calcium and magnesium. However, levels of Na, Zn, P, and K are generally lower than the optimum required, and the organic carbon stores are low. These conditions are important in better understanding the land capability ratings that are recorded, with the majority of the study area being rated as low intensity grazing land.

These poor conditions for growth were further compounded by the low organic carbon (<1.0%).

There are no indications of any toxic elements associated with the soils that are likely to limit natural plant growth.

Nutrient Storage and Cation Exchange Capacity (CEC)

The potential for a soil to retain and supply nutrients can be assessed by measuring the CEC of the soils.

The inherently low organic carbon content is detrimental to the exchange mechanisms as it is these elements which naturally provide exchange sites that serve as nutrient stores. The moderate clay contents will temper this situation somewhat with at best a moderate to low retention and supply of nutrients for plant growth.

Low CEC values are an indication of soils lacking organic matter and clay minerals. Typically a soil rich in humus will have a CEC of 300 me/100g (>30 me/%), while a soil low in organic matter and clay may have a CEC of as low as 1me/110g to 5 me/100g (<5 me/%).

Generally, the CEC values for the soils mapped in the area are moderate.

Table 2.1.7.1 Composite Sample - Analytical Results

Sample No.	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
Soil Form	Gc	Ka/Kd	We	Pn	Sd/Hu	Av	Av	Kd	Rg	Pn
Constituents mg/kg										
pH	6.5	6.9	5.8	6.2	6.4	7.1	6.2	6.2	5.2	6.2
"S" Value	5.6	22.4	11.6	10.2	22.8	12.1	8.9	22	33	18.2
Ca Ratio	72	54	58	72	68	72	70	49	62	65
Mg Ratio	33	33	20	26	34	30	24	28	34	33
K Ratio	0.7	10	22	4	4	7	4	8	9	2
Na Ratio	1.8	0.4	0.4	0.3	0.4	0.8	0.3	0.3	0.8	1.5
P	5	18	111	22	12	14	22	15	20	6
Zn	0.9	1.7	7	2	2	1.6	2	1.4	1.1	1.1
Sand	48	21	44	36	42	45	42	21	16	62
Silt	40	24	34	46	26	35	36	27	26	30
Clay	12	55	22	18	32	20	22	52	58	8

Sample No.	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20
Soil Form	We	Hu	Gc	Pn	Ka	Hu	Cv/Gf	Cv	Dr	Gc
Constituents mg/kg										
pH	6.2	5.8	5.6	6.2	5.8	6.6	5.2	6	6.3	5.5
"S" Value	5.8	5.2	22.1	14.8	31	11	3.8	11.2	5.2	4.1
Ca Ratio	65	58	66	65	62	65	66	59	70	66
Mg Ratio	10	12	30	32	34	22	22	16	28	22
K Ratio	12	12	1	1	7	4	5	18	0.6	5
Na Ratio	0.2	0.2	0.2	1.6	1.1	0.5	0.3	0.2	1.4	0.1
P	82	80	8	6	17	10	11	111	5	10
Zn	1.6	1.6	1	1.1	1.4	1.5	1.4	7.2	1	1.1
Sand	44	42	34	46	18	52	45	45	58	50
Silt	35	34	38	46	22	30	43	39	34	38
Clay	21	24	28	8	60	18	12	16	8	12

Soil organic matter

The soils mapped are generally low in organic carbon. This factor coupled with the moderate to low clay contents (generally < 25%) for the majority of the soils mapped will adversely affect the erosion indices for the soils.

2.1.7.2 Soil Physical Characteristics

The majority of the soils mapped exhibit apedal to weak crumbly structure, low to moderate clay content and a dystrophic leaching status. The texture comprises sandy to silty sands for the most part, with much finer silty loams and clay loams associated with the colluvial and alluvial derived materials associated with the lower slope and bottom land stream and river environs respectively.

Of significance to this study, and a feature that is moderately common across the site where the soils are associated with the sedimentary host rocks (albeit that it often occurs below the 1.5m auger depth on the deeper soils), is the presence of a hard pan ferricrete (plinthite) layer within the soil profile.

The semi-arid climate (negative water balance) combined with the geochemistry of the host rock geology are conducive to the formation of evaporites, with the development of ferruginous layers or zones within the vadose zone.

The accumulation and concentration of iron and manganese rich fluids in solution will result in the precipitation of the salts and metals due to high evaporation (negative water balance). This process results in the development of a restrictive or inhibiting layer/zone within the profile over time.

The negative water balance is evidenced by the generally low rainfall of 700mm/year or less, and the high evaporation that averages 1,350mm/year. These are the driving mechanisms behind the ouklip or hard pan ferricrete formations mapped.

The degree of hardness of the evaporite is gradational, with variations from soft plinthic horizons (very friable and easily *dug with a spade or shovel),* through plinthite soil *(varying in particle size from sand to gravel – but no cementation)* to nodular and hard pan ferricrete or hard plinthic *(cementation of iron and manganese into nodules)* that are not possible to free dig or brake with a shovel.

This classification is taken from - Petrological and Geochemical Classification of Laterites -*Yves Tardy, Jean-Lou, Novikoff and Claude Roquid* (1991)*,* and forms the basis to classify the hard pan ferricrete or lateritic portion of the soil horizon in terms of its workability (engineering properties) and storage sensitivities.

The soil classification system takes cognisance of ferricrete and has specific nomenclature for these occurrences (Refer to the Taxonomic Soil Classification (*Mac Vicar et al, 2nd edition 1991*), a system for South Africa – See list of references).

The variation in the consistency of the evaporite layer, its thickness and extent of influence across/under the site are all important in understanding the concept of a restrictive horizon or barrier layer that is commonly formed at the base of the soil profile and/or close to the soil surface. Where this horizon develops to a nodular form or harder (Nodular, Honeycomb and Hard Pan) the movement of water within the soil profile is restricted from vertical infiltration and is forced to move laterally or perch within the profile. It is this accumulation of soil water and the precipitation of the metals from the metal and salt rich water that adds progressively to the ferricrete layer over time.

Important to an understanding of the development of the ferricrete is the geological time and presence of the specific soil and water chemistry under which the horizon forms. This situation will be very difficult to emulate or recreate if impacted or destroyed.

2.1.8 Soil Erosion and Compaction

Erodibility is defined as the vulnerability or susceptibility of a soil to erosion. It is a function of both the physical characteristics of a particular soil as well as the treatment of the soil.

The resistance to, or ease of erosion of a soil is expressed by an erodibility factor (“K”), which is determined from soil texture/clay content, permeability, organic matter content and soil structure. The Soil Erodibility Nomograph (*Wischmeier et. al,* 1971) was used to calculate the “K” value.

With the “K” value in hand, the index of erosion (I.O.E.) for a soil can then be determined by multiplying the “K” value by the “slope” measured as a percentage. Erosion problems may be experienced when the Index of Erosion (I.O.E.) is greater than 2.

The majority of the soils mapped can be classified as having a moderate to high erodibility index in terms of their organic carbon content and clay content, albeit that this rating is off-set and tempered by the undulating to flat terrain to an index of moderate or resistant.

However, the vulnerability of the "B" horizon to erosion once the topsoil and/or vegetation are removed must not be under estimated when working with or on these soils. These horizons (B2/1) are vulnerable and rate as medium to high when exposed.

The concerns around erosion and *inter alia* compaction, are directly related to the disturbance of the protective vegetation cover and topsoil layer that will be disturbed during any construction and operational phases of the mining venture. Once disturbed, the effects and actions of wind and water are increased and will increase erosion across the site.

Loss of soil (topsoil and subsoil) is extremely costly to any operation, and is generally only evident at closure or when rehabilitation operations are compromised.

Well planned management actions during the planning, construction and operational phases will save time and money in the long run, and will have an impact on the ability to successfully "close" an operation once completed.

Phase 1 of the project has been confined to surface areas that are owned by the proponent. These areas are limited to the farms Grootpan 86 IS, Portion 5, 10, 23, 29 and Kortlaagte 67 IS Portion 4 (Refer to Figure 1.2c). The dominant soils for these areas have been cropped for easy of discussion, and have been used in conjunction with the general geomorphology of the sites in the assessment of the impact significance. These areas have been cropped from the overall project and dealt with as part of a separate Phase 1 impact assessment (Refer to Figure 2.1.6c, 2.1.6d, 2.1.6e and 2.1.6f – Phase 1 – Dominant Soils Maps).

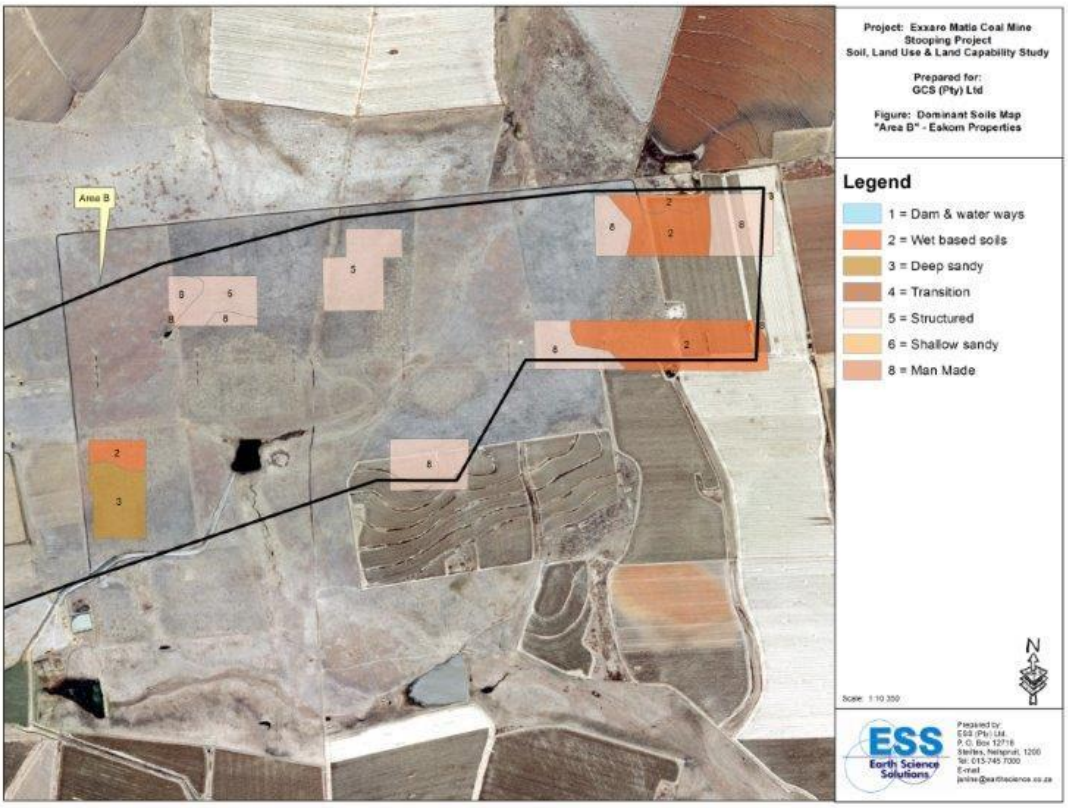


Figure 2.1.6c Dominant Soil Map of proposed Stooping Project (Area B).

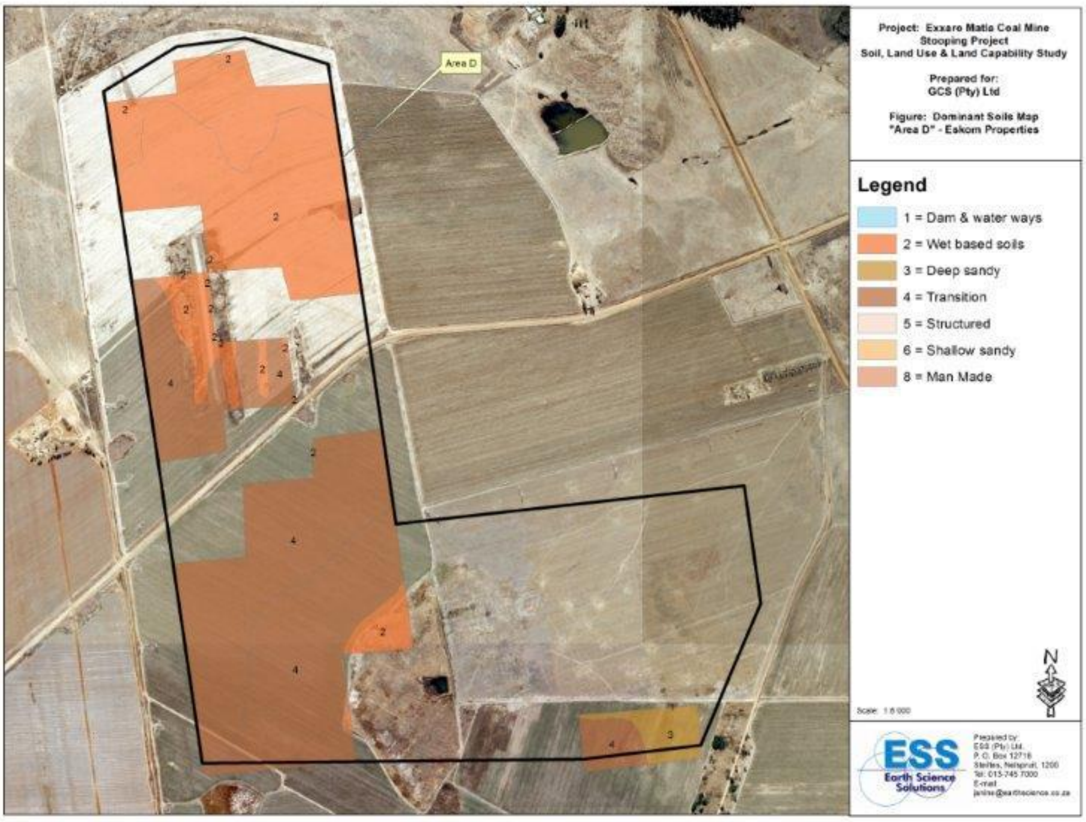


Figure 2.1.6d – Dominant Soil Map indicating the dominant soil types (Area D)

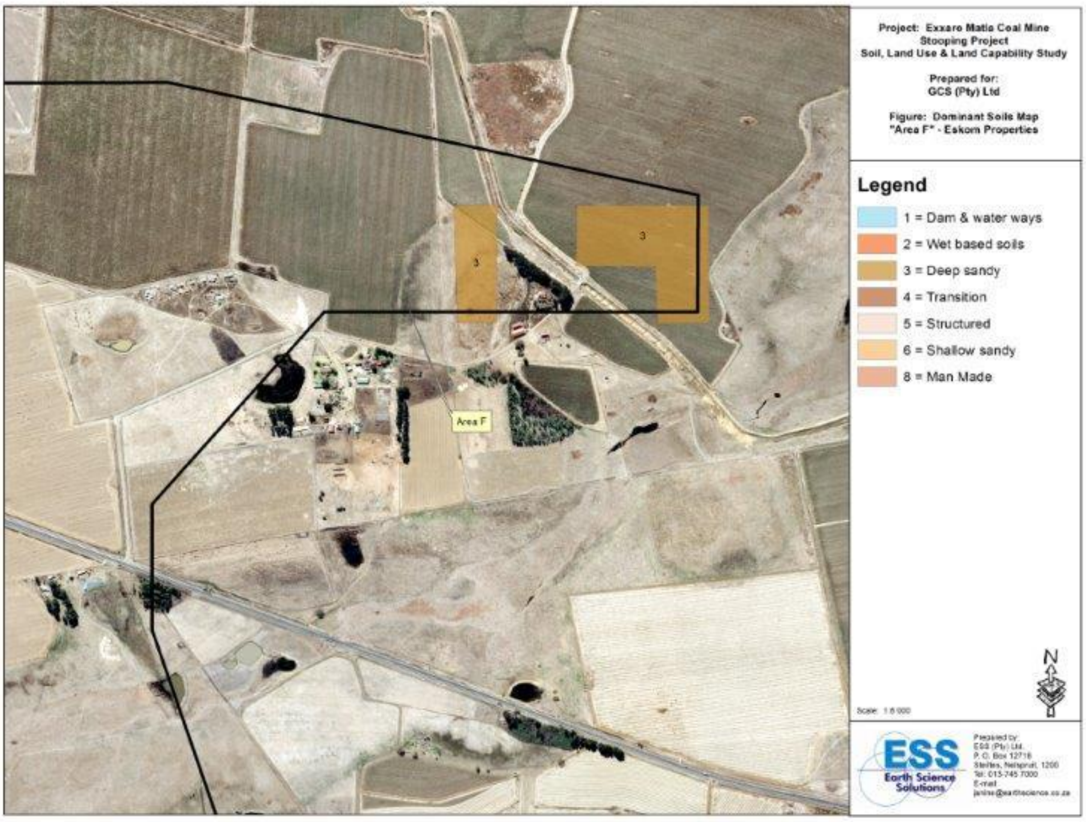


Figure 2.1.6e – Dominant Soil Map indicating the dominant soil types (Area F)

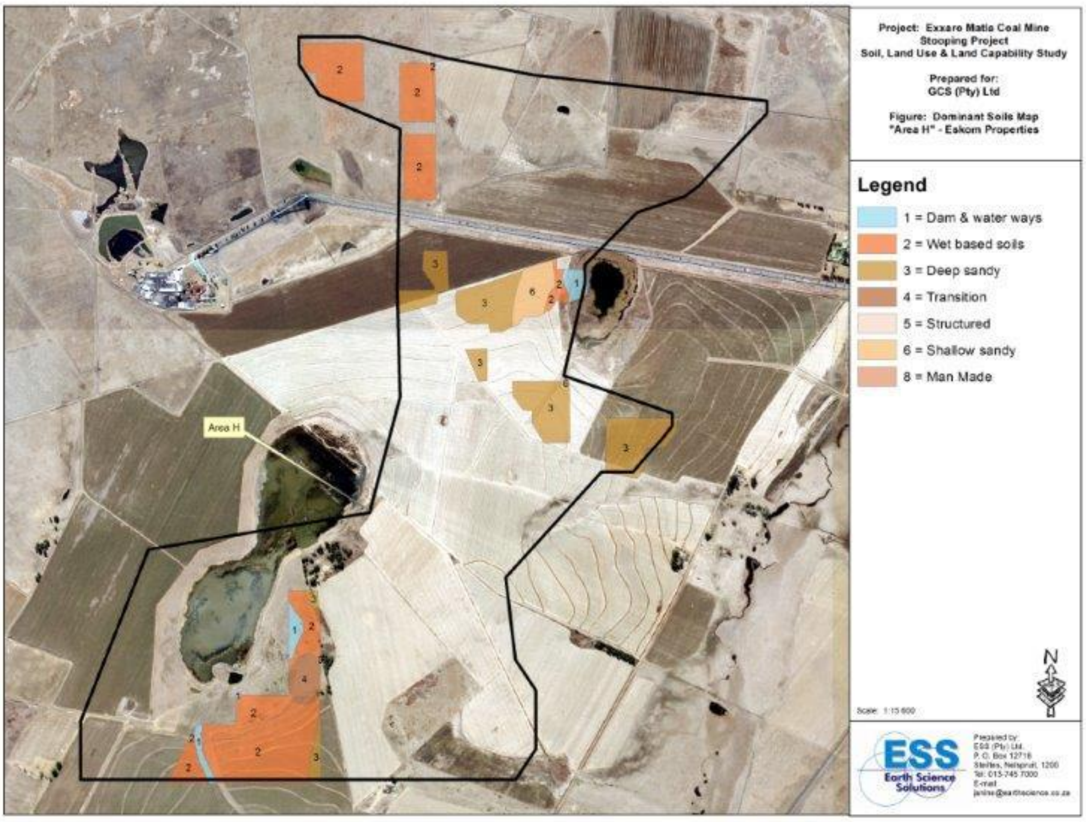


Figure 2.1.6f – Dominant Soil Map indicating the dominant soil types (Area H)

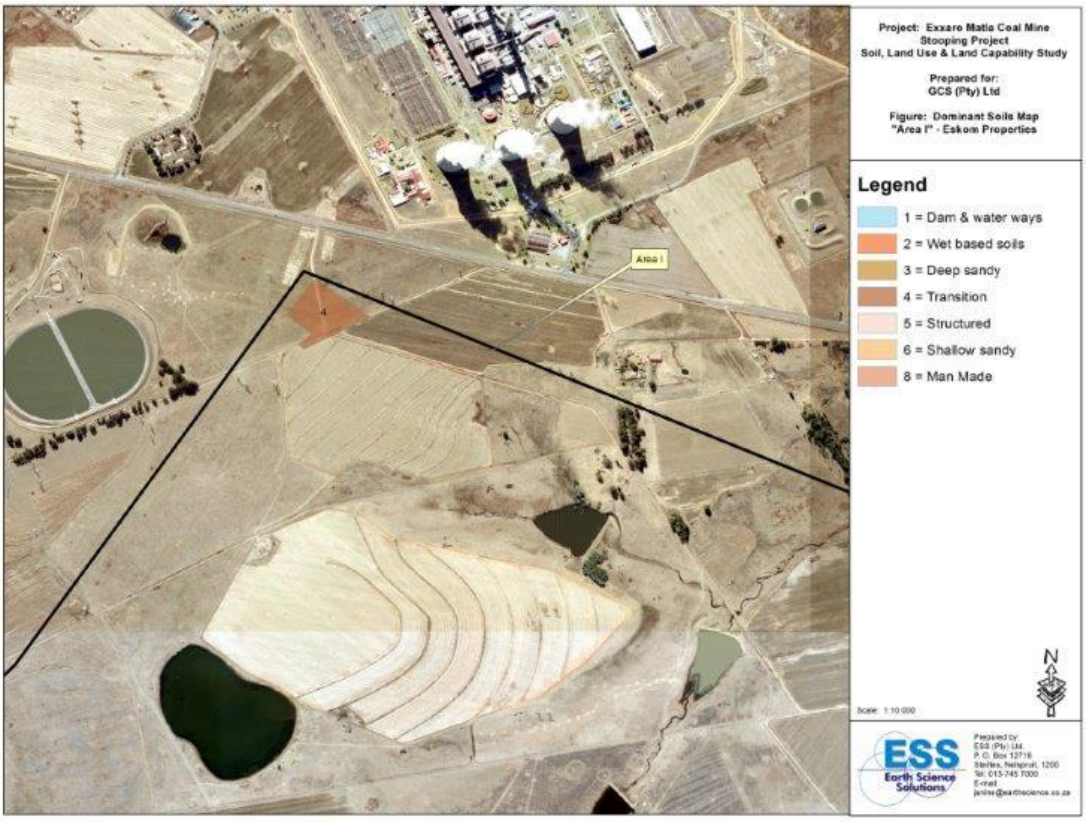


Figure 2.1.6f – Dominant Soil Map indicating the dominant soil types (Area I)

2.2 Pre-Construction Land Capability

2.2.1 Data Collection

Based on a well-developed and scientifically founded baseline of information, the South African Chamber of Mines (1991) Land Capability Rating System in conjunction with the Canadian Land Inventory System Canadian Government (2016-04) - (internationally recognised system) has been used as the basis for the land capability rating.

Using these systems, the land capability of the study area was classified into four distinctly different and recognisable classes, namely, wetland or lands with wet based soils, arable land, grazing land and wilderness or conservation land. The criteria for this classification are set out in Table 2.2.1.

Table 2.2.1 Criteria for Pre-Construction Land Capability (S.A. Chamber of Mines 1991)

Criteria for Wetland

Land with organic soils or supporting hygrophilous vegetation where soil and vegetation processes are water determined.

Criteria for Arable Land

Land, which does not qualify as having wetland soils.
The soil is readily permeable to a depth of 750mm.
The soil has a pH value of between 4.0 and 8.4.
The soil has a low salinity and SAR
The soil has less than 10% (by volume) rocks or pedocrete fragments larger than 100mm in the upper 750mm.
Has a slope (in %) and erodibility factor ("K") such that their product is <2.0
Occurs under a climate of crop yields that are at least equal to the current national average for these crops.

Criteria for Grazing Land

Land, which does not qualify as having wetland soils or arable land.
Has soil, or soil-like material, permeable to roots of native plants, that is more than 250mm thick and contains less than 50% by volume of rocks or pedocrete fragments larger than 100mm.
Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.

Criteria for Conservation of Land

Land, which does not qualify as having wetland soils, arable land or grazing land, and as a result is regarded as requiring conservation practise/actions.

2.2.2 Description

The "land capability classification" was used in conjunction with the overall geomorphology (ground roughness, topography, climate etc.) of the area to characterise and rate the land capability for the areas of concern.

The area to be disturbed by the underground stooping operation (Areas "A" to "I") and its associated surface infrastructure development comprises a range of land capability classes, with significant areas of friable and good grazing potential class soil, significant and sensitive sites that returned shallow and wet based soil conditions, and sites of structured and moderately sensitive materials that occur within the planned development footprint. The underground workings planned for stooping are overlain by the full suite of soil sensitivities and land capability, with a significantly large spatial area of more sensitive to highly sensitive wetland soil ratings associated with the rivers and associated transition zone wet based soils, sensitive to moderately sensitive sandy loams and sandy clay loams associated with the middle and upper mid-slope positions and the more sensitive to high sensitivity shallow soils associated with the ridge slopes and erosive environment.

Figure 2.2.2a illustrates the distribution of land capability classes across the total study area, while Figures 2.2.1b, 2.2.1c, 2.2.1d, 2.2.1e and 2.2.1f illustrate the land capability distribution for the areas that are to be mined as part of the Phase 1 Project. The assessment of impact on the land capability has been separated into the proposed Phase 1 mining (Stooping under areas that are owned by Exxaro and Eskom) and the future mining plan.

Arable Land

Arable potential land is confined almost entirely to the deep and more friable soil forms, with the majority of the areas in question rather returning moderate to good quality grazing land.

These ratings are in spite of the fact that some soil depths are reflective of an arable status (>750mm), with the growth potential (nutrient status and soil water capabilities) and ability of these soils to return a cropping yield equal to or better than the national average is lacking. This is due mainly to the low than acceptable nutrient stores and the variable climatic conditions. These variables reflect the natural conditions, and do not include any man induced additives such as fertilisers or water (irrigation).

Grazing Land

The classification of grazing land is generally confined to the shallower and transitional zones that are well drained. These soils are generally darker in colour, and are not always free draining to a depth of 750mm but are capable of sustaining palatable plant species on a sustainable basis, especially since only the subsoil's (at a depth of >500mm) are periodically wetted. In addition, there should be no rocks or pedocrete fragments in the upper horizons of this soil group. If present it will limit the land capability to wilderness land.

The majority of the study area classifies as moderate to low intensity grazing land and/or wilderness status.

Wilderness / Conservation Land

The shallow rocky areas and soils with a structure that is stronger than Vertic (strong blocky) are characteristically poorly rooted, and support at best very low intensity grazing or more realistically are of a wilderness land capability rating and character.

Wetland (Areas with wetland status soils)

Wetland areas in this document (soils and land capability) are defined in terms of the wetland delineation guidelines, which use both soil characteristics, the topography as well as floral and faunal criteria to define the domain limits (Separate wetland delineation has been undertaken). Only the soils are described here.

These zones (wetlands) are dominated by hydromorphic soils (wet based) that often show signs of structure, and have plant life (vegetation) that is associated with seasonal wetting or permanent wetting of the soil profile (separate study).

The wetland soils are generally characterised by dark grey to black (organic carbon) in the topsoil horizons and are often high in transported clays and show variegated signs of mottling on gleyed backgrounds (pale grey colours) in the subsoil's. Wetland soils occur within the zone of soil water influence.

A significant but relatively small proportion of the study area classifies as having wet based soils. However it is important to note that a significantly large area of the open pit and infrastructure development being planned encroaches on soils with a wet base.

These should not be mistaken as wetlands in terms of the delineation document, but should be highlighted as potential zones of sensitivity with the potential for highly sensitive areas associated with the prominent waterway that cross cut the mining development.

These zones are considered very important, highly sensitive and vulnerable due to their ability to contain and hold water for periods through the summers and into the dry winter seasons.

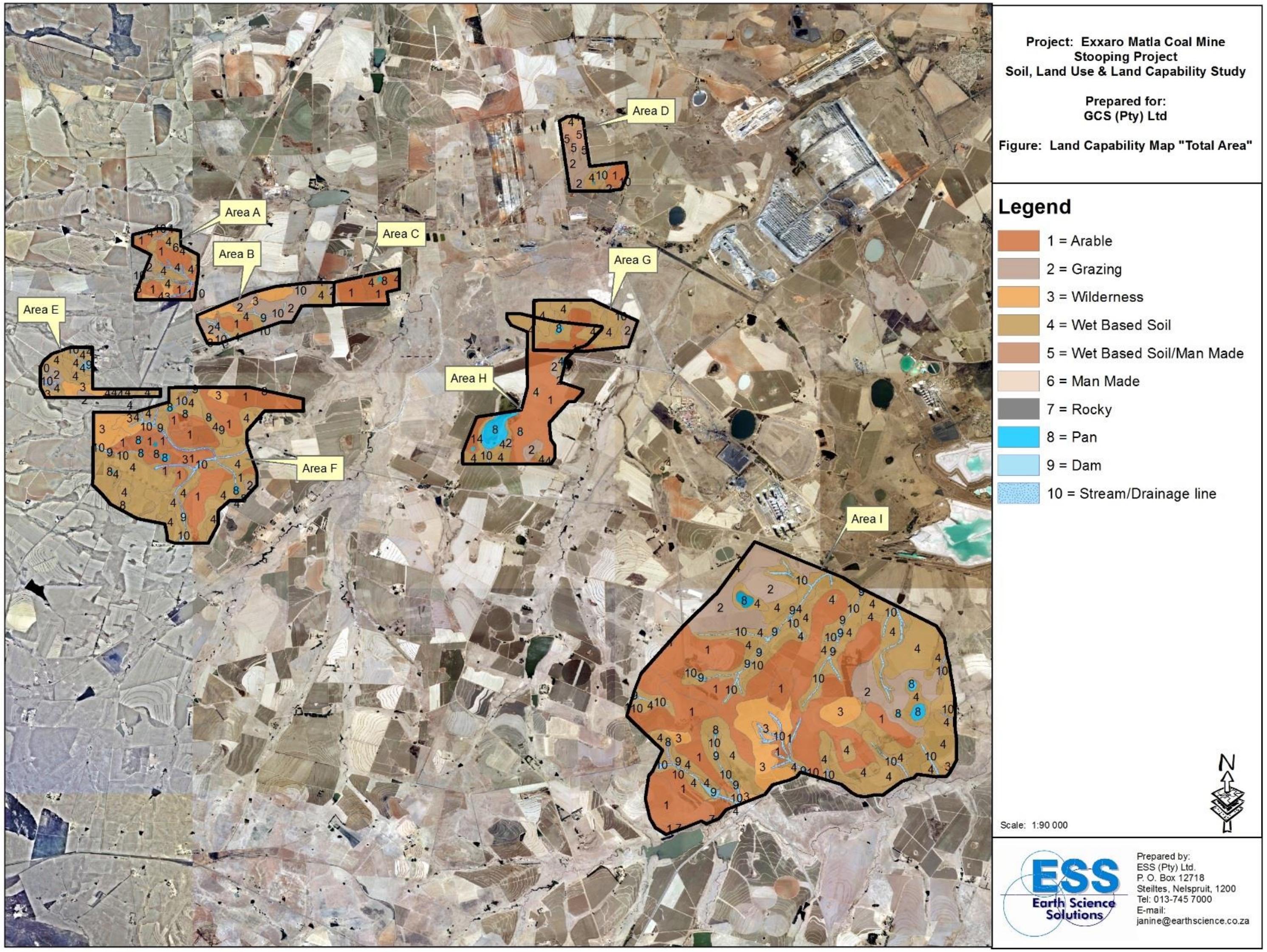


Figure 2.2.2a Land Capability Map of the Exxaro Matla Coal Mine Proposed Stooping Project Area (Areas A to I)

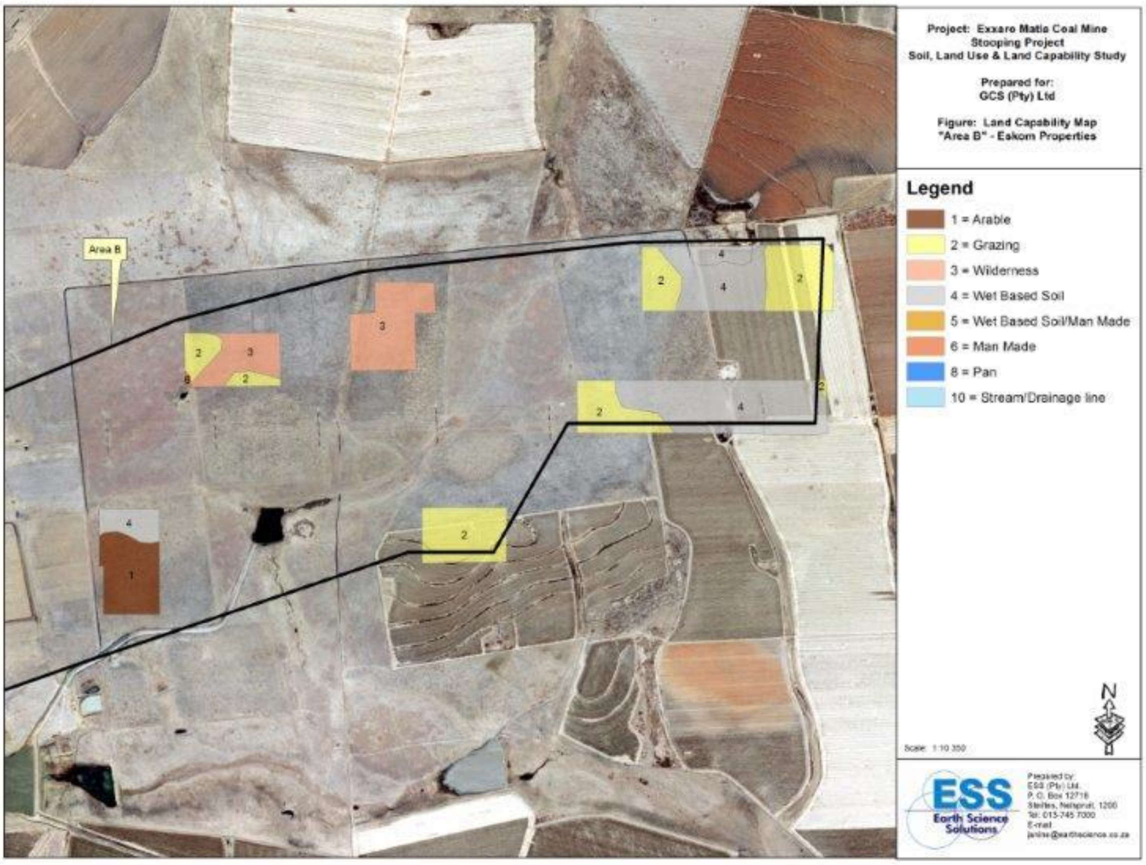


Figure 2.2.2a Land Capability Map of Area B - Stooping Project

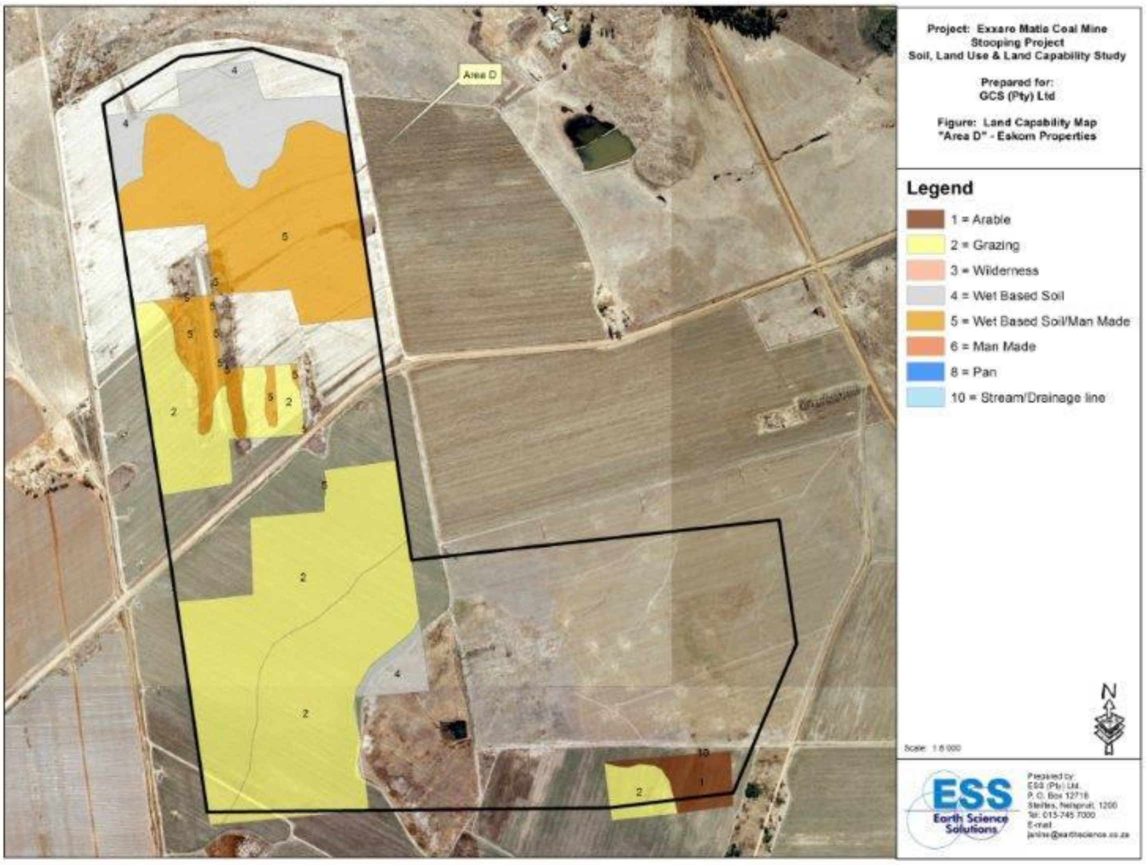


Figure 2.2.2a Land Capability Map of Area D - Stooping Project

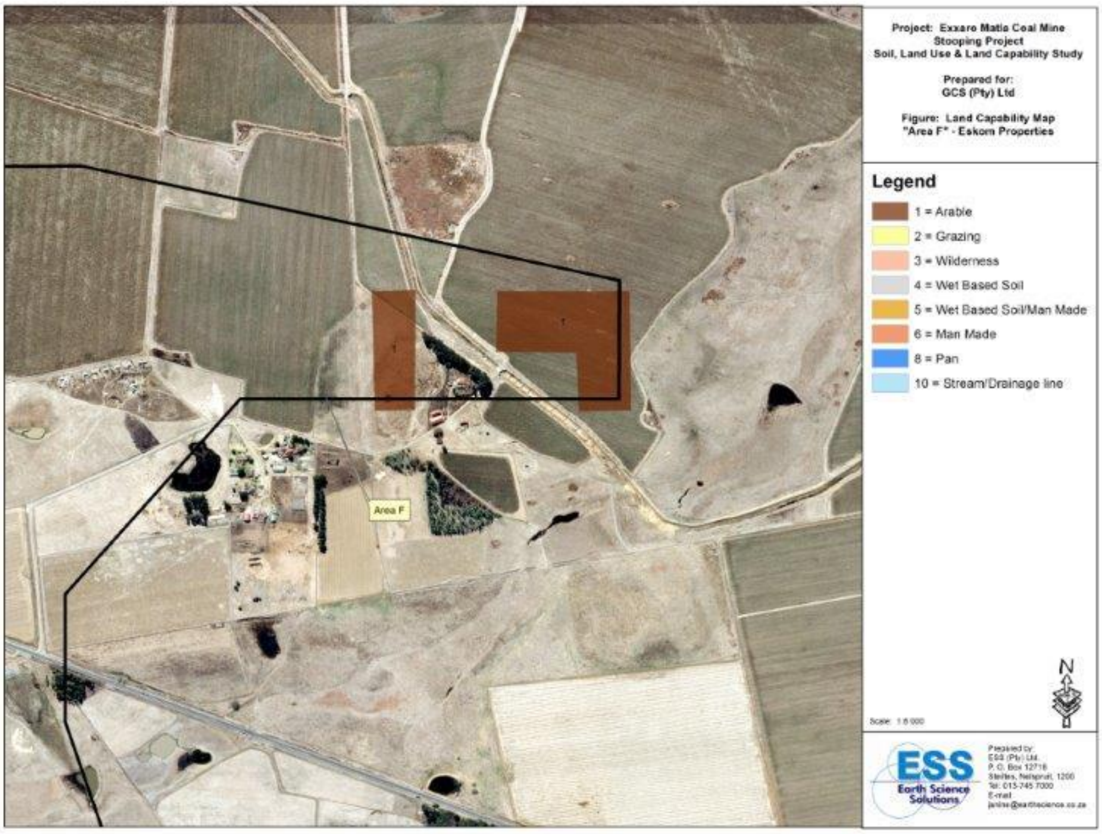


Figure 2.2.2a Land Capability Map of Area F - Stooping Project

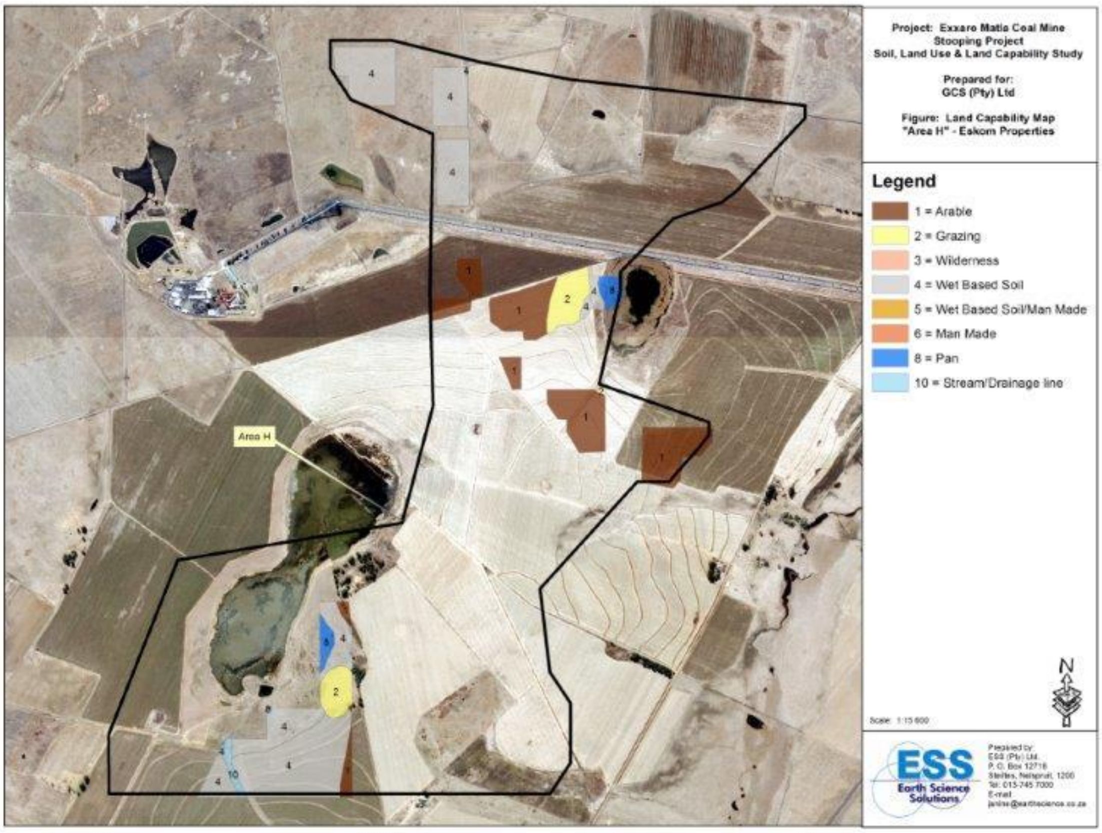


Figure 2.2.2a Land Capability Map of Area H - Stooping Project

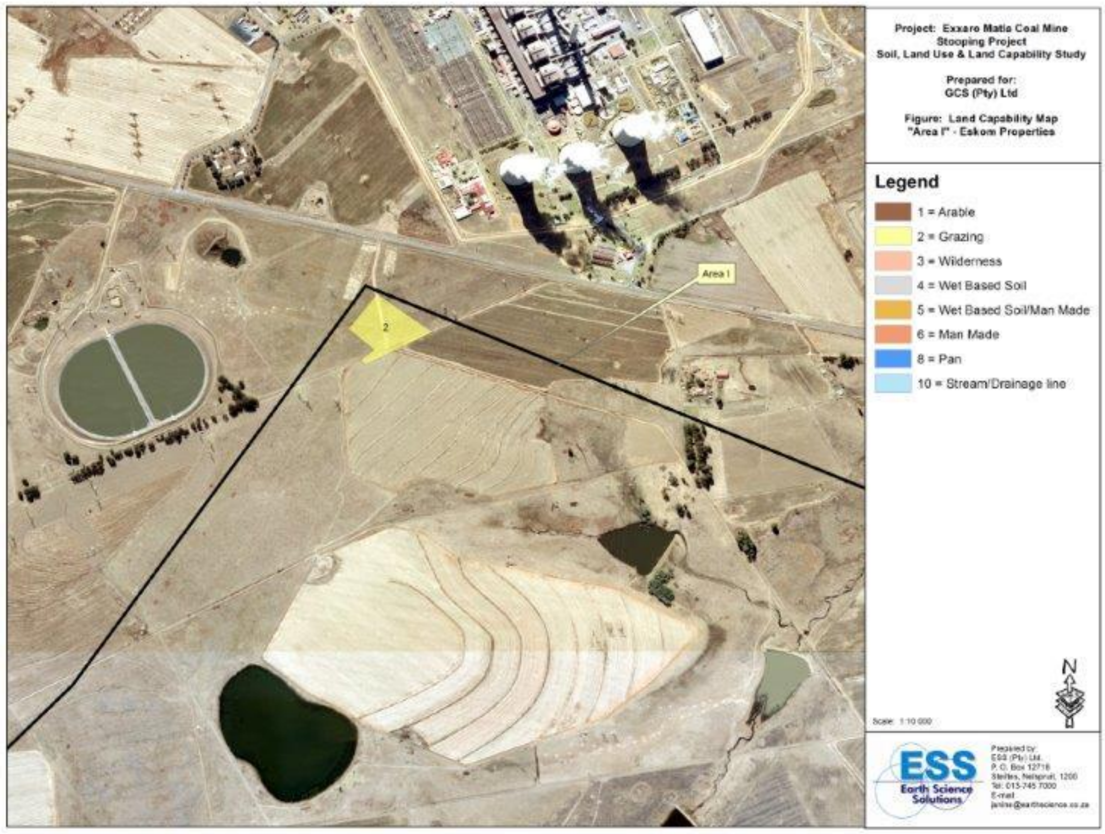


Figure 2.2.2a Land Capability Map of Area I - Stooping Project

2.3 Pre-Construction Land Use

The land use in the study area was assessed using a number of data sets, both historical as well as information obtained from the recent field studies, the aerial photographic coverage and discussions with the project team. In addition, the time spent in field while mapping the soils and classifying the land capability added to the understanding of the land use and land coverage (Refer to Figure 2.3a, b, c, d and e – Pre Development Land Use Map for the stooping project).

In general, the land use of the study area is considered to be altered, with a significant portion of the area having been changed from its original grassland biome to commercial farmlands.

The lower lying areas associated with the wetlands and wet based soils are for the most part unchanged, albeit that cultivation and utilisation of areas within this zone for livestock grazing and crop production were noted. On balance, the remainder of the site has been developed to either intensive grazing of the natural veld grasses or to commercial crops and cultivated pastures.

There is little to no subsistence farming practiced in the area, and no other commercial industry or urban dwellings exist. Homesteads and farm employees living on the land are the only other dwellings noted on the area.

Areas of historical and more recent coal mining are evident within the area of concern, albeit that the majority of the mining has been by underground bord and pillar system to date.

A more intensive study of the particular crop varieties and livestock ventures has not been undertaken, with the socio economic study having better access to these information and data sets.

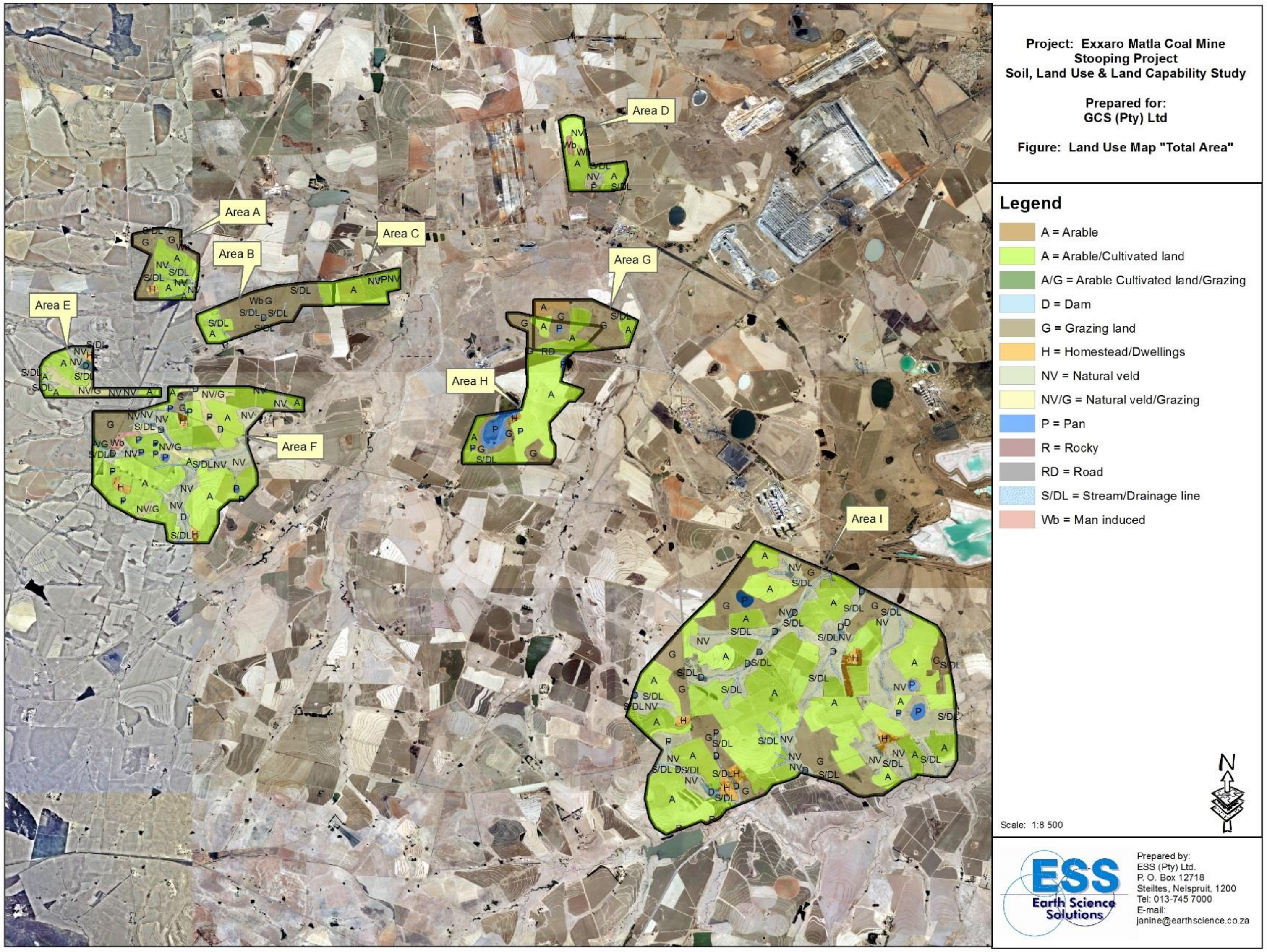


Figure 2.3a **Pre-construction Land Use Map of the Exxaro Matla Coal mine Stooping Project area (Total Areas A-I)**

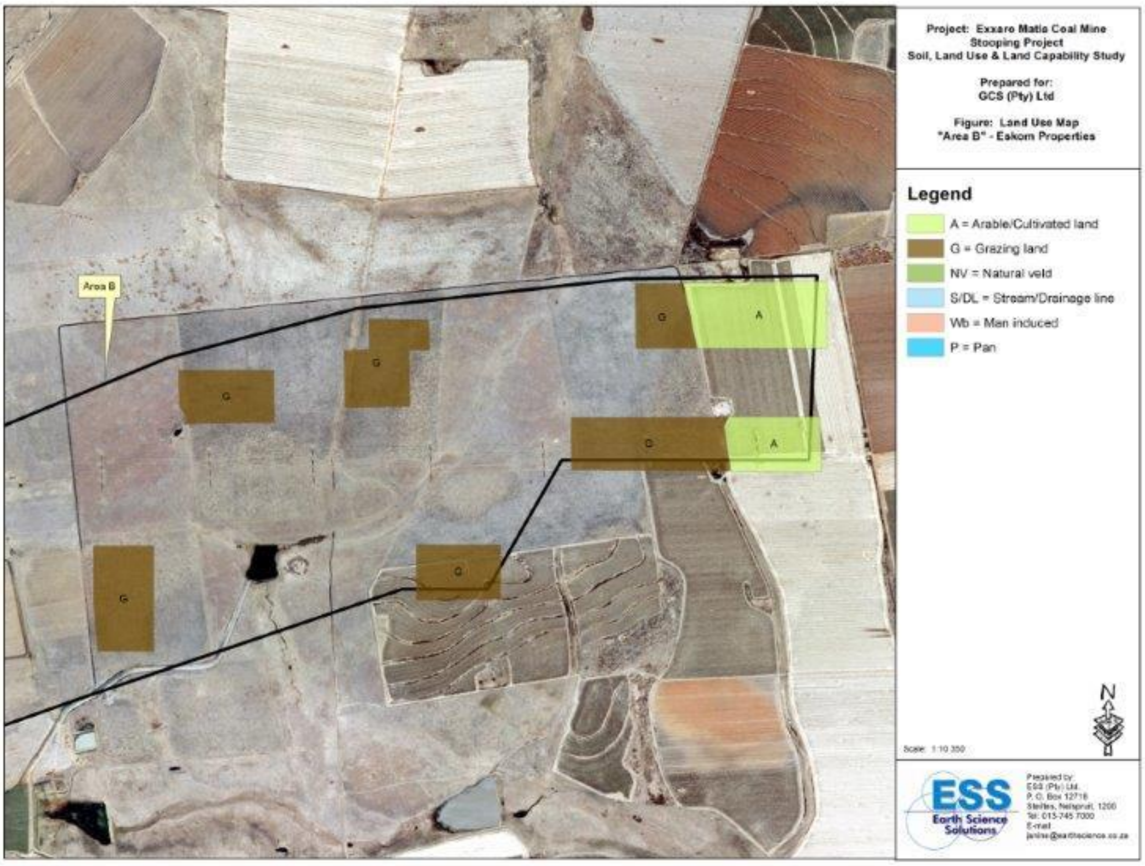


Figure 2.3b **Pre-construction Land Use Map of Exxaro Stooping Project (Area B)**

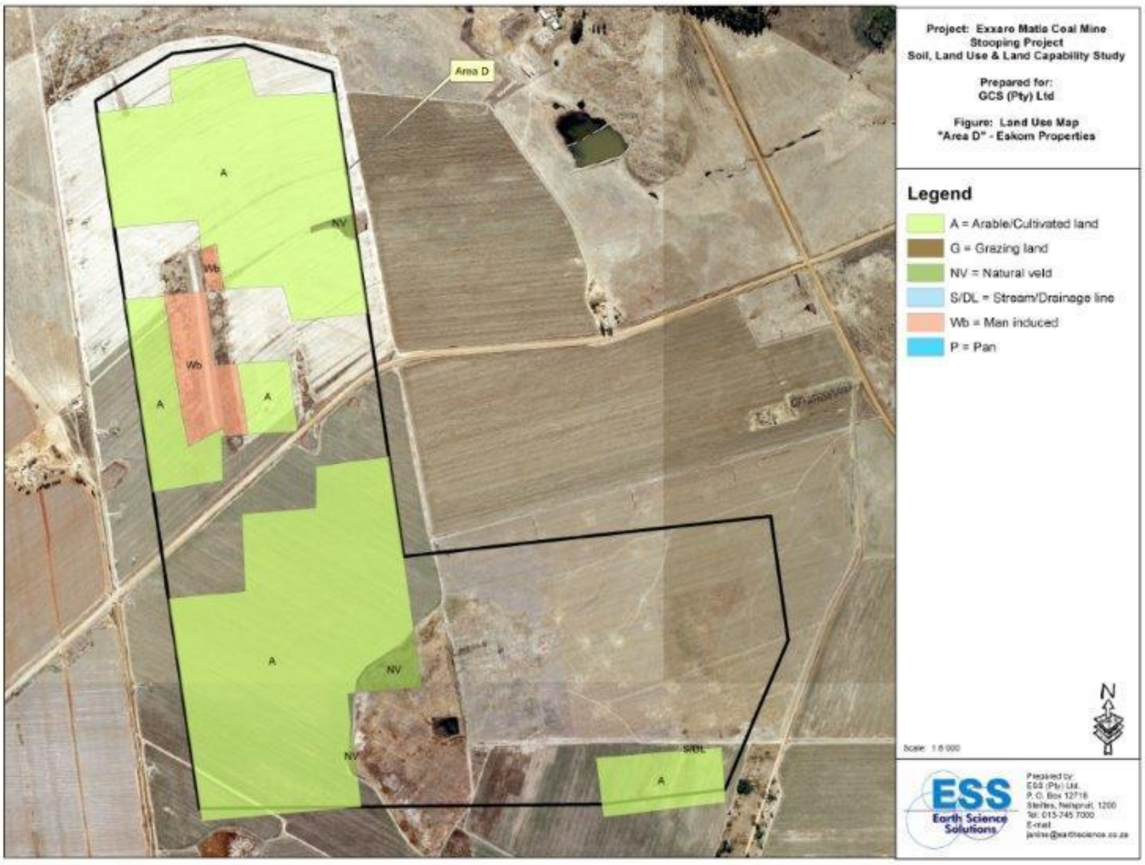


Figure 2.3c **Pre-construction Land Use Map of Exxaro Stooping Project (Area D)**

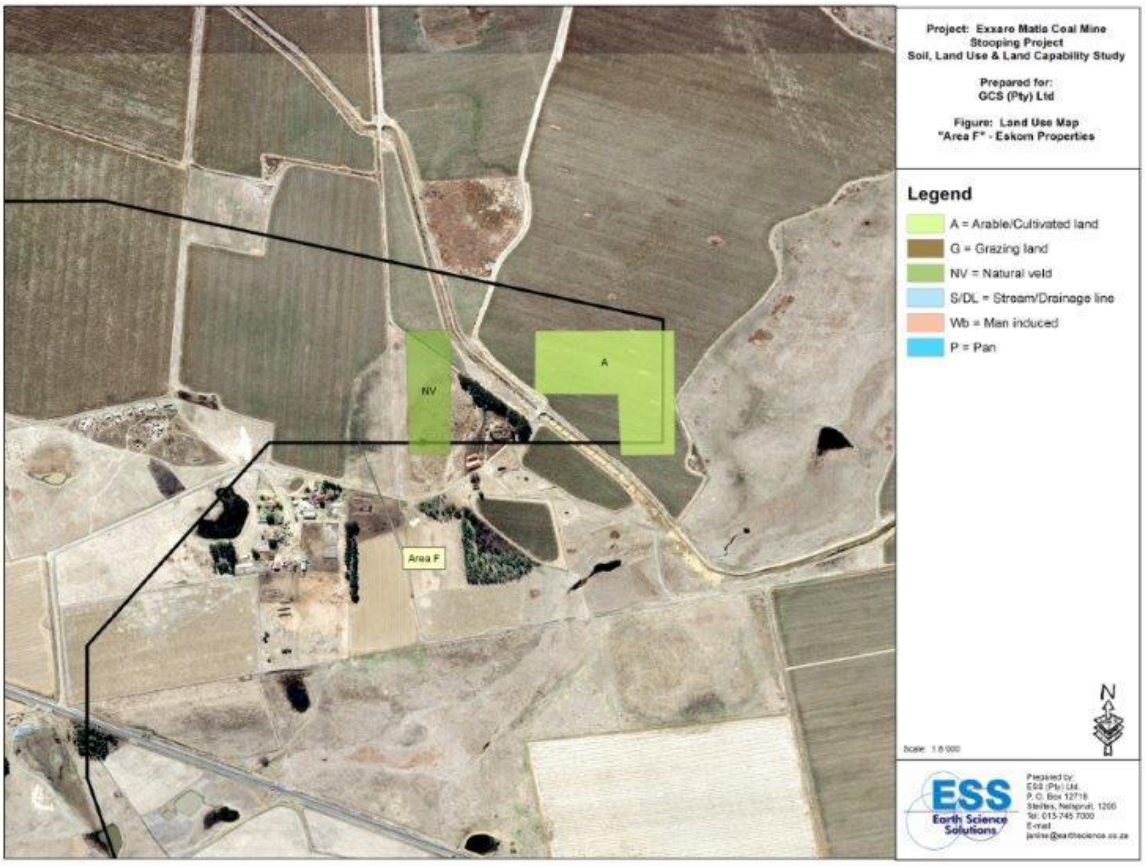


Figure 2.3d **Pre-construction Land Use Map of Exxaro Stooping Project (Area F)**

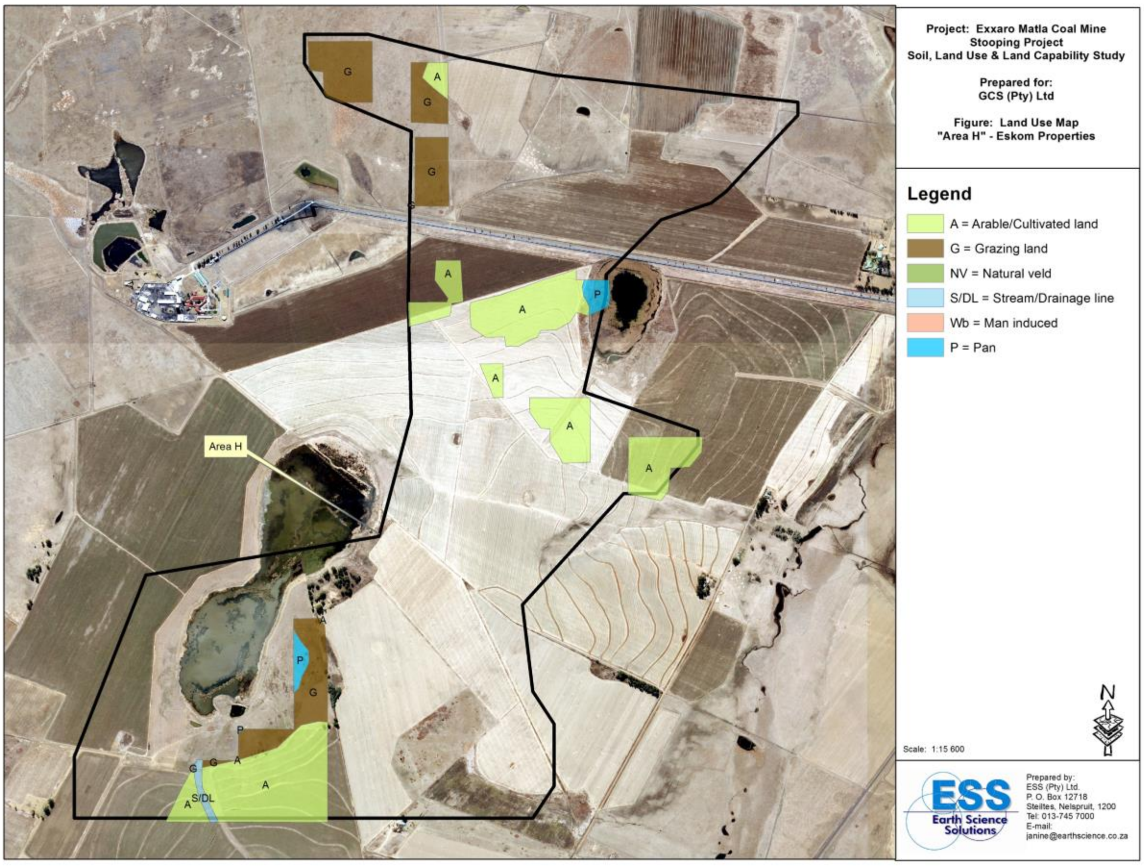


Figure 2.3e **Pre-construction Land Use Map of Exxaro Stooping Project (Area H)**

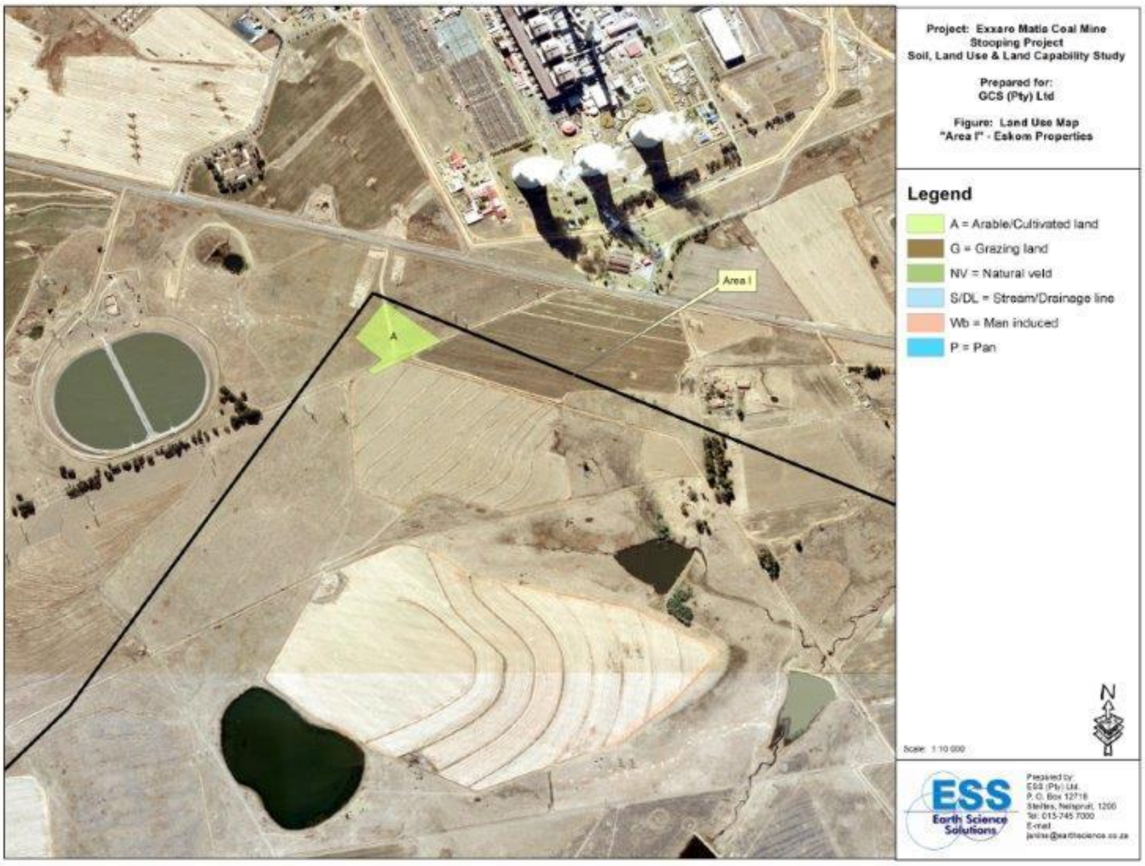


Figure 2.3f **Pre-construction Land Use Map of Exxaro Stooping Project (Area I)**

3. ENVIRONMENTAL IMPACT ASSESSMENT - PHILOSOPHY

With the baseline assessment in hand, and the determination of the existing state of the environment covered, the relative sensitivities of the sites/areas of concern have been delineated (Refer to Figure 3a – Total Area of concern, Figure 3b and 3c – Phase 1 of the Stooping Project) and used as the basis for the Environmental Impact Assessment of the overall management plan.

The impact assessment has been considered in terms of two distinct phases, with the Phase 1 Development (Figures 3b and 3c) comprising those areas of underground stooping where the surface rights (land ownership) are owned by the proponent, and the "Future Stooping" considered at a later stage as Phase 2. These aspects have been separated in terms of impact significance rating for ease of management.

This report has been compiled in line with the South African Integrated Environmental Management Information Series (DEAT 2002), a guideline to the Impact Assessment philosophy and Significance Rating System.

This system aims to identify and quantify the environmental and/or social aspects of the proposed activities inclusive of any alternatives, to assess how these aspects will affect the existing state, and link the aspects to variables that have been defined in terms of the baseline study.

In addition, the impact assessment has defined a maximum acceptable level of impact for each of the activities or variables, inclusive of any standards, limits and/or thresholds, and will assess the impact in terms of the significance rating as defined.

This will require that the cumulative effects are considered, and that the common sources of impact are detailed.

The environmental aspects are not least of all part of the information that is needed in this decision making, with an understanding of how the soils and land capability will be affected being just part of the overall sustainability equation that needs to be balanced.

With the information available (historic and current) and the results of the comprehensive baseline studies (soils and land capability), and with the development proposals for the proposed project in hand, the areas of concern have been assessed and management measures proposed to minimise and mitigate the impacts wherever possible.

Based on the outcomes of the impact assessment, the management planning and mitigation measures have been defined and detailed. These include defining what the mitigation will do to reduce the intensity and probability of the impact, specify a performance expectation for the mitigation proposed.

In addition, and as part of the practical management plan, a monitoring system has been defined and any legal limits or provisions listed.

As part of understanding the variables and the maximum acceptable levels of impact that will be considered by the authorities, a summary of the national legislation that pertains to soils has been considered. These will aid in setting the permissible standards and limits that can be considered, albeit that there are no prescribed limits available.

The following section outlines a summary of the South African Environmental Legislation that needs to be considered for any new development with reference to management of soil:

- *The law on Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.*
- *The Bill of Rights states that environmental rights exist primarily to ensure good health and wellbeing, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources.*
- *The Environmental right is furthered in the National Environmental Management Act (No. 107 of 1998), which prescribes three principles, namely the precautionary principle, the "polluter pays" principle and the preventive principle.*
- *It is stated in the above-mentioned Act that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source.*
- *Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Environmental Conservation Act 73 of 1989, the Minerals Act 50 of 1991 and the Conservation of Agricultural Resources Act 43 of 1983.*
- *The National Veld and Forest Fire Bill of 10 July 1998 and the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947 can also be applicable in some cases.*
- *The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimized and remedied.*
- *The Minerals Act of 1991 requires an EMPR, in which the soils and land capability be described.*
- *The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and water courses are also addressed*.

In addition to the South African legal compliance as listed, the proposed development has also been assessed in terms of the International Performance Standards as detailed by the International Finance Corporation as a matter of best practice.

The IFC has developed a series of Performance Standards to assist developers and potential clients in assessing the environmental and social risks associated with a project and assisting the client in identifying and defining roles and responsibilities regarding the management of risk.

Performance Standard 1 establishes the importance of:

- Integrated assessment to identify the social and environmental impacts, risks, and opportunities of projects;
- Effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and
- The client's management of social and environmental performance throughout the life of the project.

Performance Standards 2 through 8 establish requirements to avoid, reduce, mitigate or compensate for impacts on people and the environment, and to improve conditions where appropriate. While all relevant social and environmental risks and potential impacts should be considered as part of the assessment.

Performance Standards 2 through 8 describe potential social and environmental impacts that require particular attention in emerging markets. Where social or environmental impacts are anticipated, the client is required to manage them through its Social and Environmental Management System consistent with Performance Standard 1.

Of importance to this report are:

- The requirements to collect adequate baseline data;
- The requirements of an impact/risk assessment;
- The requirements of a management program;
- The requirements of a monitoring program; and most importantly;
- To apply relevant standards (either host country or other).

With regard to the application of relevant standards (either host country or other) there are no specific guidelines relating to soils and land use/capability, either locally or within the World Bank's or IFC's suite of Environmental Health and Safety Guidelines. The World Bank's Mining and Milling, Underground guideline does state, however, that project sponsors are required to prepare and implement an erosion and sediment control plan. The plan should include measures appropriate to the situation to intercept, divert, or otherwise reduce the stormwater runoff from exposed soil surfaces, tailings dams, and waste rock dumps.

Project sponsors are encouraged to integrate vegetative and non-vegetative soil stabilization measures in the erosion control plan.

Sediment control structures (e.g., detention/retention basins) should be installed to treat surface runoff prior to discharge to surface water bodies. All erosion control and sediment containment facilities must receive proper maintenance during their design life. This will be included in the appropriate management plans when they are developed at a later stage in the project's life cycle.

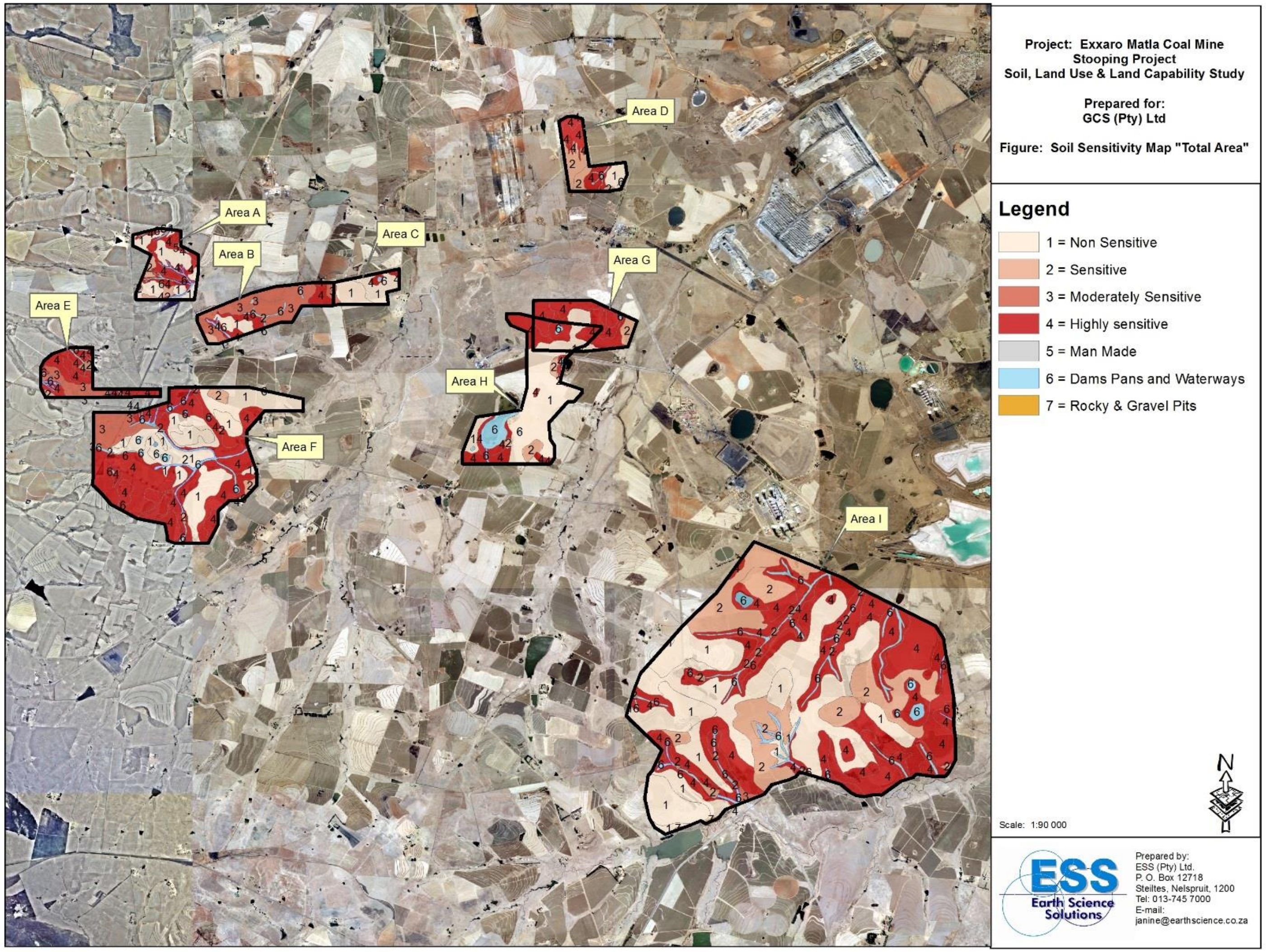


Figure 3a Soil Sensitivity Map of the Exxaro Matla Coal Mine Stooping Project indicating the sensitivity of soils at the proposed stooping area (Areas A-I)

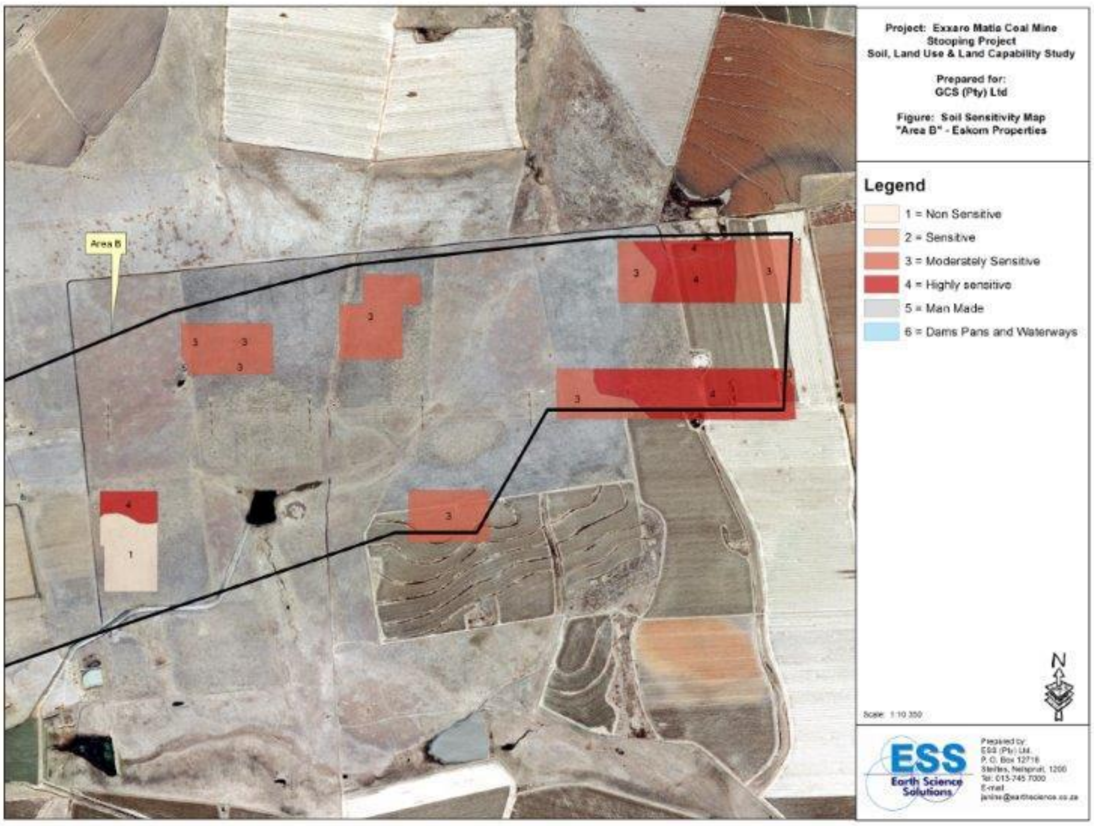


Figure 3b Soil Sensitivity - Exxaro Matla Stooping Project of Area B

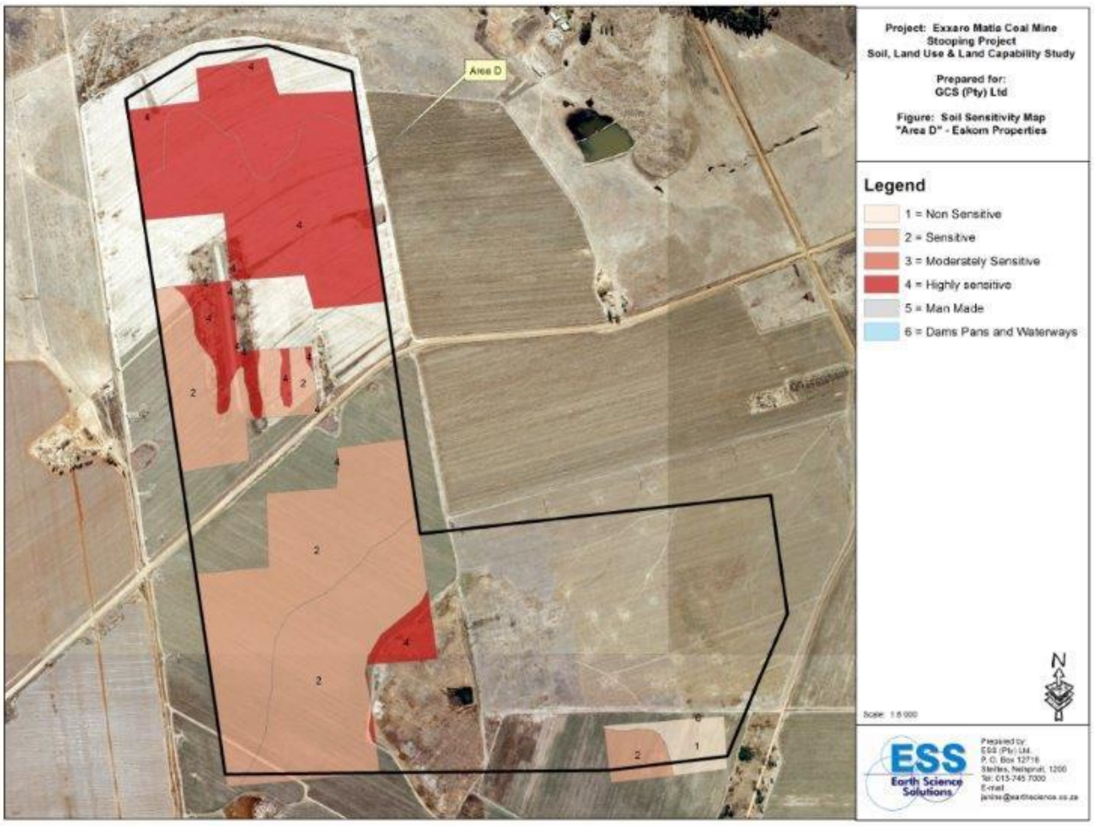


Figure 3c Soil Sensitivity - Exxaro Matla Stooping Project of Area D

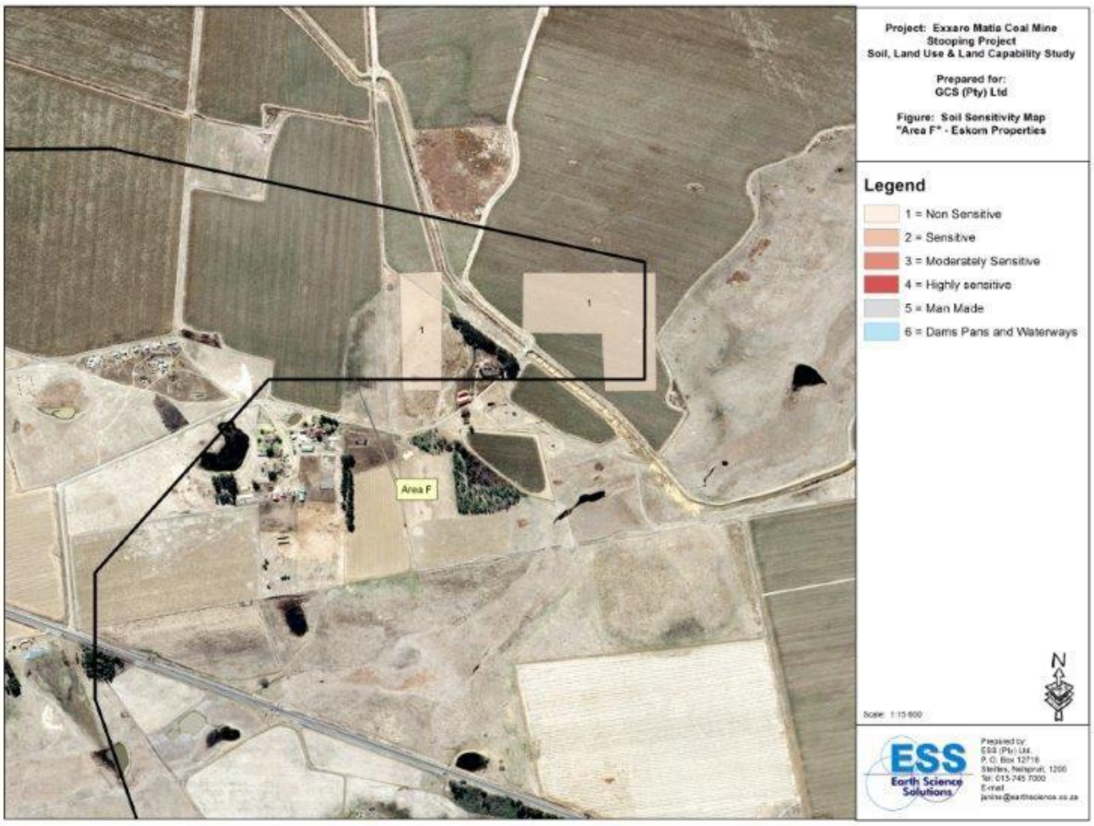


Figure 3d Soil Sensitivity - Exxaro Matla Stooping Project of Area F

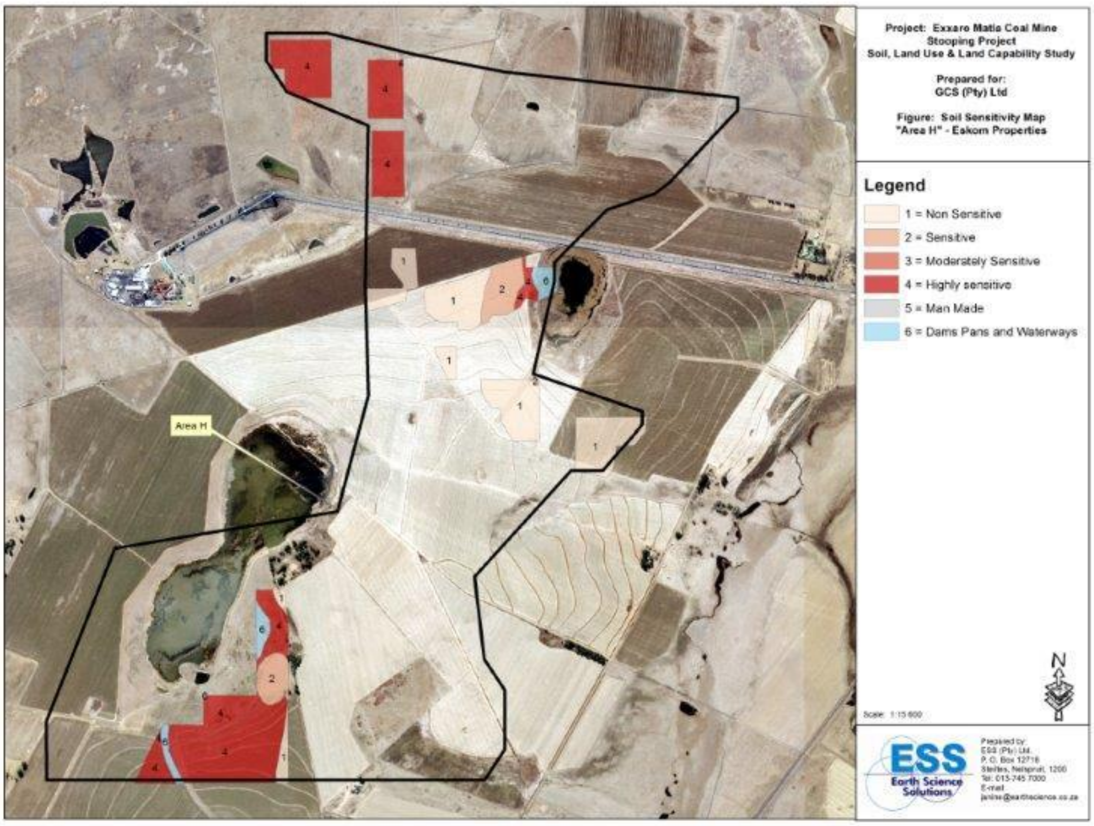


Figure 3e Soil Sensitivity - Exxaro Matla Stooping Project of Area H

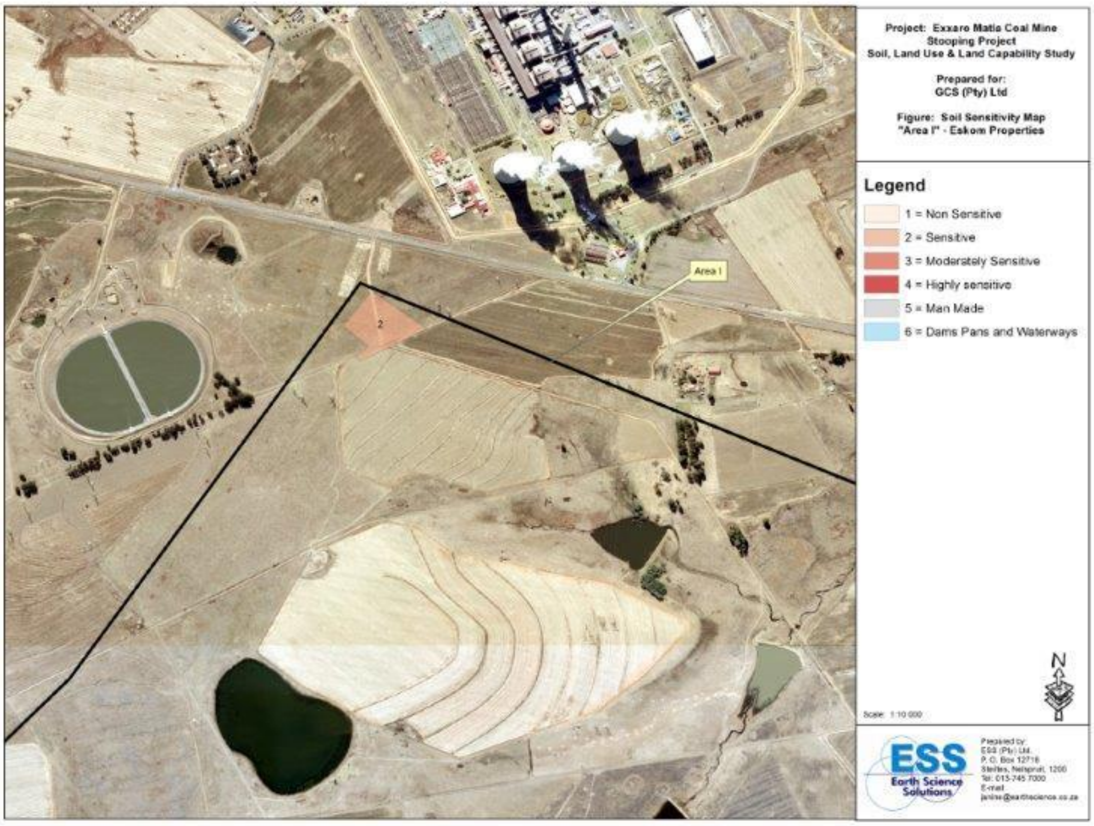


Figure 3f Soil Sensitivity - Exxaro Matla Stooping Project of Area I

The variation in soil structure, texture and clay content of the soils combined with the presence of a prominent ferricrete (evaporite) layer at the base of some of the soil profile ("C" Horizon), all make for a complex of natural conditions that are going to be extremely difficult to replicate during the rehabilitation stage and at closure (refer to section 5 for impact significance).

The potential and probable loss of soil water and the "perched" aquifer that is believed to occur as a result of the ferricrete inhibiting/barrier layer will need to be assessed and understood as a function of the ecological balance.

The low levels of organic carbon and relatively low nutrient stores noted for many of the soils will also require that a sound management plan (refer to section 6) is adopted based on the best impact assessment information.

The concept of "**utilisable soil**" storage will be tabled as a basic management tool, and a function of good environment practise.

All of the soils mapped are sensitive to erosion and compaction to varying degrees and, although tempered by the relative flatness of the terrain, they will need a well formulated management plan and adequate engineering if the soils are exposed and disturbed.

In addition, the variable depth profiles of the materials mapped are of concern as the depths of utilisable soil that can be stripped and stored will make for challenging management if all of the utilisable soils are to be harvested (large volumes).

These soils are extremely important to the long term sustainability of the project. Soils will need to be stripped during construction, stored and maintained during the operational stage, and reinstated at closure (rehabilitation and emplacement of stored soils).

The impact of development on the soils and the resultant change in the land capability will be varied due to the unique differences associated with the soil forming processes and the resultant variation in the soil physical and chemical composition. The materials range from well-developed in-situ derived sandy and silty loams associated with the sedimentary lithologies to clay rich and well-structured sandy clays and clay loams associated with the more basic intrusive lithological units. These are contrasted with the more recent colluvial and alluvial derived soils that return less well defined pedogenisis and comprise a range of structure and texture.

These factors will be important in the environmental assessment and final management plan that is tabled, with the “separation” and management of the differing materials at the removal stage (construction) forming the basis for economically and sustainable rehabilitation at closure.

The moderately complex nature of the geology (physical and chemical) and geomorphology of the area (ferricrete land form) and the semi-arid climate, all play a significant role in the soil forming process, and have a bearing on the sensitivity and/or vulnerability of the materials when being worked or disturbed.

These factors are important not only in planning the construction and operational activities, but will determine the success of the rehabilitation planning for the future.

4. SIGNIFICANCE RATING SYSTEM

4.1 Impact Assessment Methodology

The following Impact Assessment Methodology has been utilised when assessing the impacts of the proposed activities on each specialist fields of study.

Generally, impact assessment is divided into three parts:

- Issue identification - the evaluation of the 'aspects' arising from the project description and the identification of salient issues associated with the area of expertise;
- Impact definition – defining of the positive and negative impacts identified that are associated with the issues and activities as detailed in the project description as well as any others that the specialist might believe are pertinent;
- The definition statement should include the activity (source of impact), aspect and receptor as well as whether the impact is direct, indirect or cumulative. Fatal flaws should also be identified at this stage.
- Impact evaluation – this is not a purely objective and quantitative exercise. It has a subjective element, often using judgment and values as much as science-based criteria and standards. The need therefore exists to clearly explain how impacts have been interpreted so that others can see the weight attached to different factors and can understand the rationale of the assessment.

4.2 Impact significance rating

The impact significance rating system is presented in Table 4.2 and involves four parts:

- Part A: Define impact consequence using the three primary impact characteristics of magnitude, spatial scale/population and duration;
- Part B: Use the matrix to determine a rating for impact consequence based on the definitions identified in Part A;
- Part C: Use the matrix to determine the impact significance rating, which is a function of the impact consequence rating (from Part B) and the probability of occurrence; and
- Part D: Define the Confidence level.

This environmental impact assessment has been undertaken based on the Block Plan 0000-1729-000-L002 (Refer to Figure 1-2a and 1-2b) and the Phase 1 Mining Plan (Figures 1-2c and 1-2d2b).

Table 4.2 Significance Rating System

PART A: DEFINING CONSEQUENCE IN TERMS OF MAGNITUDE, DURATION AND SPATIAL SCALE *Use these definitions to define the consequence in Part B*		
Impact characteristics	**Definition**	**Criteria**
MAGNITUDE	Major	Substantial deterioration or harm to receptors; receiving environment has an inherent value to stakeholders; receptors of impact are of conservation importance; or identified threshold often exceeded
	Moderate	Moderate/measurable deterioration or harm to receptors; receiving environment moderately sensitive; or identified threshold occasionally exceeded
	Minor	Minor deterioration (nuisance or minor deterioration) or harm to receptors; change to receiving environment not measurable; or identified threshold never exceeded
	Minor+	Minor improvement; change not measurable; or threshold never exceeded
	Moderate+	Moderate improvement; within or better than the threshold; or no observed reaction
	Major+	Substantial improvement; within or better than the threshold; or favourable publicity
DURATION	Short term	Up to 18 months.
	Medium term	18 months to 5 years
	Long term	Longer than 5 years
SPATIAL SCALE OR POPULATION	Site or local	Site specific or confined to the immediate project area
	Regional	May be defined in various ways, e.g. cadastral, catchment, topographic
	National/ International	Nationally or beyond

PART B: DETERMINING CONSEQUENCE RATING *Rate consequence based on definition of magnitude, spatial extent and duration*					
			SPATIAL SCALE/ POPULATION		
			Site or Local	**Regional**	**National/ international**
MAGNITUDE					
Minor	**DURATION**	**Long term**	Medium	Medium	High
		Medium term	Low	Low	Medium
		Short term	Low	Low	Medium
Moderate	**DURATION**	**Long term**	Medium	High	High
		Medium term	Medium	Medium	High
		Short term	Low	Medium	Medium
Major	**DURATION**	**Long term**	High	High	High
		Medium term	Medium	Medium	High
		Short term	Medium	Medium	High

PART C: DETERMINING SIGNIFICANCE RATING *Rate significance based on consequence and probability*				
		CONSEQUENCE		
		Low	**Medium**	**High**
PROBABILITY (of exposure to impacts)	**Definite**	Medium	Medium	High
	Possible	Low	Medium	High
	Unlikely	Low	Low	Medium

PART D: CONFIDENCE LEVEL		
High	Medium	Low

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1 Activities Listing

The EIA methodology and philosophy is covered in the preceding section, while the activities that require assessment are considered as two distinct phases (Phase 1 and Phase 2) for the impact assessment. The findings/significance ratings are based on the proposed mine plan for the Phase 1 Development (Underground Mining by Stooping Methods of Areas "B", "D", "F", "H" and "I"), and Phase 2 Development (Future Stooping Areas). The activities for the two phases are similar and will include:

Phase	Activities
Operational	Underground mining and stooping of pillars
	Stockpiles, including run of mine (ROM), overburden and topsoil where needed
	Conveying of coal from shaft complex to existing beneficiation and processing facilities
	Operation of ventilation shafts and management of stockpiled materials
Closure/Rehabilitation	Demolish all surface infrastructure
	Rehabilitation of shaft area, conveyor route servitude and all associated infrastructure
Post-closure	Potential decant of groundwater

An assessment of the environmental impacts that the activities might produce has been carried out and measured against the existing environmental state using the significance rating supplied.

This section assesses and measures/quantifies the environmental aspects of the **activities** in terms of how they will affect the **existing state** and details where possible/available the maximum acceptable level of impact for each of the variables listed.

Based on these findings, the **significance** of the impact is rated in terms of its unmanaged and managed state, with the management recommendations forming the basis of the Environmental Management Plan (Chapter 6).

The difference in the significance of the expected impacts based on soil form or group will potentially influenced the design criteria and positioning of infrastructure.

There are no off-site activities included in this Environmental Impact Assessment. The assessment is confined to the project footprint and its immediate surroundings, and as such the "spatial extent is regarded as "Site Only" or at worst "Localised" depending on how far the effects of erosion are predicted to extend.

The infrastructure planned for the facility will include deep excavations (shafts) and the use of heavy machinery over unprotected ground. These will entail the removal of significant quantities of soil, and the complete removal of soil and soft overburden from areas were deep foundations are required.

The haulage ways and conveyencing routes will be required to carry heavy vehicles and loads from the Adit/Shaft Head to the RoM Stockpile, and will require strong foundations with resultant deep excavation and engineering of the sub base.

In contrast, any access roads, conveyer lines and general service ways will require less intensive engineering and the actions and effects will not be as invasive on the natural materials, albeit that all linear features/activities (conveyencing lines, water pipelines and electrical reticulation) will definitely impact negatively on some highly sensitive soils along the planned route if not well defined ahead of the build.

The mining and associated activities will inevitably sterilise some soils and they will be lost from the system for the life of the operation and possibly beyond if the systems are to be utilised for future ventures and mining projects.

With an understanding of the general high level planning, it is evident that the concerns and probable impacts that could affect the soils, land use and the land capability are associated with:

- The loss of the soil resource due the **change in land use** and the removal of the resource from the existing system (Sterilisation). These are generally associated with the construction of the facilities and the use of the footprint area for industrial/mining activities and support infrastructure. These activities will potentially result in the complete loss of the soil resource for the life of the project and possibly for some time after closure. In addition, the management of waste could potentially sterilize the soils permanently (if soils are not removed), and if not well managed;
- The loss of the soil resource due to the **erosion** (wind and water) of unprotected materials (removal of vegetative cover and/or topsoil);
- The loss of the utilisation potential of the soil and land capability due to **compaction** of areas adjacent to the constructed facilities;
- Loss of the resource due to **removal** of materials for use in related activities;
- The loss of utilisation potential due to the collapse of the underground workings while stooping of the pillars and the potential for **salinisation and contamination** of the soils on surface;
- The **contamination** of the resource due to spillage of raw materials or final product and/or spillage of reagents transported to the site that are used in the process;
- The **contamination** of stored and/or in-situ materials due to dust deposition or dirty water from the project area and transport routes;
- The loss of the soil utilisation potential due to the **disturbance** of the soils and potential loss of nutrient stores through infiltration and de-nitrification of the stored or disturbed materials.

Of significance to the proposed development and the sustainability of any project are the relative sensitivities of the soils (Refer to Figure 3a, 3b and 3c – Total Area and Phase 1 areas respectively).

The sensitivities are generally associated with shallow soils, wetness within the profile and the erosion potential of a soils. The occurrence of ferricrete is indicative of their having been, or the presence of wetness within a profile, and although many of the ferricrete horizons mapped are believed to be associated with “relic land forms”, there are a number of areas where these features are associated with topographic low lying areas, pans and present day wetness within the profile.

In terms of the wetland delineation guidelines and the legal status of wetlands the highly sensitive areas need to be considered carefully if they are within the area of proposed impact. These features are important to the biodiversity and ecology of the area and need to be understood in the context of the overall systems that sustain the pre development environment.

Structure and the shallowness of soil rooting depths are also aspects considered when measuring the robustness or sensitivity of the soil.

The noted (baseline study) differences in the texture of the soil forms, the soil depth variations, the composition of the "C" horizon (ferricrete), the relative wetness of subsoil's and the structure of the different soil groups is of importance in assessing the potential impacts and the relative sensitivity that is assigned to the soil groups and land capabilities that are to be effected.

Collapse of the underground workings is a definite result that will potentially reflect at surface. The impact of surface collapse and the effect on the ferricrete will influence both the retention of soil water within the vadose zone with the braking of the inhibiting layer (ouklip) and the movement of water down the profile and the potential for the accumulation of water and the salinisation of the soils in areas were the water ponds and is unable to move out of the topography and down slope. All of these results are considered negative and will impact on the soils, their land capability and the ecosystem services of the area in general.

5.2 Impact Assessment

5.2.1 Preconstruction Phase

The project only relates to stooping of the underground pillars, with no additional surface infrastructure to be constructed. The only pre-construction activity will be to obtain the necessary environmental authorisations before continuing with the operational phase.

5.2.2 Construction Phase

The project only relates to stooping of the underground pillars, with no additional surface infrastructure to be constructed. The support infrastructure is already authorised and the transport of coal to the plant, stockpiles etc will be a continuation thereof.

5.2.3 Operational Phase

5.2.3.1 Underground Mining (Stooping)

Issue: Loss of utilisable resource (Sterilisation and erosion), compaction, de-nutrification and contamination or salinisation.

The operation of the mining venture (Underground Stooping of pillars) will see the possible impact of subsidence of ground at surface due to the collapse of the underground workings and the formation of "cracks" to surface as the pillars are removed. This will potentially result in contamination of the soil water (vadose zone) and ultimately the ingress of poor quality water to the fractured rock aquifer.

In summary, the operation will potentially result in:

- The loss of the soil resource due to ponding and salinisation of the in-situ materials and the sterilisation over time of the ecosystem services associated with the collapse areas that are undermined by stooping;
- The creation of dust and the possible loss (erosion) of utilisable soil down-wind and/or downstream, and the potential for contamination of the soils from dust fallout and dirty water runoff from vehicles used in the repair of subsidence and areas of ponding at surface (if concurrent rehabilitation is undertaken);
- Contamination of soils by use of dirty water for road wetting (dust suppression) and irrigation of the stockpile vegetation;

Impact Significance

The result of the operation on the soil resource will have a negative impact rating potential that is major in magnitude, that will last for the life of the operation (permanent to irreversible if not rehabilitated) and be confined to the immediate site.

In the un-managed scenario the frequency is likely to be continuous resulting in a significance rating of high

It is inevitable that some of the soils will be lost during the operational phase if they are not well managed and a mitigation plan is not made part of the general management schedule.

However, these impacts may be mitigated with well initiated management procedures.

These should include:

- Minimisation of the area that can potentially be impacted (eroded, compacted, sterilised or de-nutrified);
- The design and implementation of well-engineered mining schedules that compensate for the collapse and manage the ponding of water. The rectification of the landform by well managed landscaping of the undermined areas to be free draining;
- Timeous replacement of the soils so as to minimise/reduce the area of affect and disturbance (cracking at surface and the development of ponds within the landscape);
- Soil replacement and the preparation of a seed bed to facilitate and accelerate the re-vegetation program and to limit potential erosion on all areas that become available for rehabilitation (temporary servitudes), and
- Soil amelioration (rehabilitated and stockpiled) to enhance the growth capability of the soils and sustain the soils ability to retain oxygen and nutrients, thus sustaining vegetative material during the storage stage.

It will be necessary as part of the development plan to maintain the integrity of the stored soils so that they are available for rehabilitation at decommissioning and closure. If the soil quantities and qualities are (utilisable soils) well managed throughout the operational phase, rehabilitation costs will be reduced and natural attenuation will more easily and readily take effect. This will result in a more sustainable “End Land Use” being achieved.

Residual Impact

In the long term (Life of the operation) and if implemented correctly, the above mitigation measures will reduce the impact on the utilisable soil reserves (erosion, contamination, sterilisation) to a significance rating of medium.

However, if the soils are not retained/stored and managed, and a workable management plan is not implemented the residual impact will definitely incur additional costs and result in the impacting of secondary areas (Borrow Pits etc.) in order to obtain cover materials etc.

Table 5.2.3.1 Operational Phase – Impact Significance – Phase 1 Stooping Project

OPERATIONAL PHASE									
Activity	Phase 1 - Underground stooping of coal pillars.								
Project Phase	Operational Phase								
Impact Summary	Loss of soil resource and eco system services (erosion), sterilisation of stockpiled materials (loss of soil nutrients) , contamination and salinisation of in-situ and stored materials by dirty water in areas of ponding and where topographic levels are compromised due to surface collapse, and the potential for compaction of materials exposed to unprotected utilisation. Contamination of vadose zone and underying aquifers if ponded water is able to ingress.								
Potential Impact Rating	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Unmanaged	Major	Site or Loc	Long Term	High	Definite	**High**	-ve	High
Management Measures	Minimisation of area of footprint								
	Concurent and timeous replacement of the soils after mining and as part of rehabilitation, with attention to landscaping of the final land form as part of the rehabilitation considerations. A free draining land form is important to soil and water quality.								
	Effective soil and vegetative cover to in-situ and stored materials, and								
	Control and auditing of vehicle movements and regular servicing of equipment								
	Storm water and dirty water management of all facilities - runoff and ponding								
After management Measures	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Managed	Moderate	Site	Long Term	Medium	Possible	**Medium**	-ve	Medium
Activity	Conveyencing of coal from Shaft Complex to Matla beneficiation Plant								
Project Phase	Operational Phase								
Impact Summary	Loss of resource and eco system services, sterilisation of soils and loss of soil utilisation potential, salinisation and/or contamination due to spillage of raw materials, dust and/or dirty water or hydrocarbons from vehicles and machinery. Compaction of peripheral soils if unprotected.								
Potential Impact Rating	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Unmanaged	Major	Site or Loc	Long Term	High	Definite	**High**	-ve	High
Management Measures	Minimisation of area of potential impact and concurrent rehabilitation of areas that are nolonger needed for the activity								
	Effective soil and vegitative cover and timeous replacement of soils onto areas that can be rehabilitated								
	Regular cleaning and maintenance of systems and containment of spillage. Adequate stormwater controls.								
	Maintenance of integrety of stored soils, monitoring of nutrient store etc.								
After management Measures	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Managed	Moderate	Site	Long Term	Medium	Possible	**Medium**	-ve	Medium

Table 5.2.3.2 Operational Phase – Impact Significance – Phase 2 Development (Future Stooping Project)

OPERATIONAL PHASE									
Activity	Development and mining by underground stooping and haulage of raw materials to surface (mechanical mining).								
Project Phase	Operational Phase								
Impact Summary	Loss of soil resource and eco system services, sterilisation (loss of soil nutrients) , contamination and salinisation of in-situ and stored materials by dirty water runoff and/or the ponding of water due to collapse of underground workings, and the compaction of materials exposed to unprotected utilisation								
Potential Impact Rating	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Unmanaged	Major	Site or Loc	Long Term	High	Definite	**High**	-ve	High
Management Measures	Minimisation of area of footprint.								
	Concurent and timeous replacement of the soils after mining and as part of rehabilitation, with emphasis on the maintenance of a free draining landscape on areas that have been stooped of the underground coal pillars. Subsidence of the surface topography will require landscaping to obtain a free draining landform.								
	Effective soil and vegetative cover to in-situ and stored materials, restriction on heights of soil dumps/stockpiles and the channeling of surface water.								
	Control and auditing of vehicle movements and regular servicing of equipment.								
	Storm water and dirty water management of all facilities - runoff and ponding								
After management Measures	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Managed	Moderate	Site	Long Term	Medium	Possible	**Medium**	-ve	Medium
Activity	Haulage/Conveyencing of coal to Matla Beneficiation Works.								
Project Phase	Operational Phase								
Impact Summary	Loss of resource and eco system services, sterilisation of soils and loss of soil utilisation potential, salinisation and/or contamination due to spillage of raw materials, dust and/or dirty water or hydrocarbons from vehicles and machinery. Compaction of peripheral soils if unprotected.								
Potential Impact Rating	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Unmanaged	Major	Site or Loc	Long Term	High	Definite	**High**	-ve	High
Management Measures	Minimisation of area of potential impact and concurrent rehabilitation of areas that are nolonger needed for the activity								
	Effective soil and vegatitive cover and timeous replacement of soils onto areas that can be rehabilitated								
	Regular cleaning and maintenance of systems and contaiment of spillage. Adequate stormwater controls.								
	Maintenance of integrety of stored soils, monitoring of nutrient store etc.								
After management Measures	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Managed	Moderate	Site	Long Term	Medium	Possible	**Medium**	-ve	Medium

5.2.4 Decommissioning & Closure Phase

5.2.4.1 Rehabilitation of Mining areas (Subsidence and associated impacts)

Issue: Net loss of soil volumes and utilisation potential due to change in material status (Physical and Chemical) and loss of nutrient base.

The impacts on the soil resource during the decommissioning and closure phase will potentially have both a positive and a negative effect, with:

- The loss of the soils original nutrient store and organic carbon by leaching of the soils while in storage;
- Erosion and de-oxygenation of materials while stockpiled;
- Compaction and dust contamination due to vehicle movement while rehabilitating the areas impacted by mining and its associated infrastructure;
- Contamination of replaced soils by use of dirty water for plant watering and dust suppression on roadways;
- Hydrocarbon or chemical spillage from contractor and supply vehicles;
- Positive impacts of reduction in areas of disturbance and return of soil utilisation potential, uncovering of areas of storage and rehabilitation of compacted materials.
- Erosion management/reduction due to slope stabilization and re-vegetation of disturbed

<u>Impact Significance</u>

The impact will remain the net loss of the soil resource if no intervention or mitigating strategy is implemented. The magnitude will remain moderate and negative for all of the activities if there is no active management (rehabilitation and intervention) in the decommissioning phase, and closure will not be possible. This will result in an irreversible impact that is continuous.

However, with interventions and well planned management, there will be a medium to low positive impact, albeit that the effects of heavy machinery and the movement of the soils will potentially have a low negative effect on erosion, contamination and compaction until the rehabilitation process has been completed. Dust will potentially also be generated depending on the degree of management implemented.

The positive impacts of rehabilitation on the area are the reduction in the footprint of disturbance, the amelioration of the affected soils and oxygenation of the growing medium, the stabilising of slopes land form contouring (free draining slopes) and the revegetation of disturbed areas. These actions will likely reduce the significance rating to low or medium positive, while the land capability will likely be returned to a grazing status.

<u>Residual Impacts</u>

On closure of the mining operation the long-term negative impact on the soils will be reduced from a significance ranking of moderate to low if the management plan set out in the Environmental Management Plan is effectively implemented.

Chemical amelioration of the soils will have a low but positive impact on the nutrient status (only) of the soils in the medium term.

Table 5.2.4.1 Decommissioning Phase – Impact Significance – Phase 1 Stooping Project

<table>
<tr><th colspan="10">CLOSURE/REHABILITATION PHASE</th></tr>
<tr><td>Activity</td><td colspan="9">Rehabilitation of Affected Mining Areas</td></tr>
<tr><td>Project Phase</td><td colspan="9">Rehabilitation</td></tr>
<tr><td>Impact Summary</td><td colspan="9">Net Loss of soil volume and utilisation potential due to change in material status (physical and chemical) and loss of nutrient base (de-nutrification), potential for compaction, erosion and contamination, while reinstatement will increase the footprint of rehabilitated grazing land potential.</td></tr>
<tr><td rowspan="2">Potential Impact Rating</td><td>Management</td><td>Magnitude</td><td>Spatial Scale</td><td>Duration</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>Pos/Neg</td><td>Conf. Level</td></tr>
<tr><td>Unmanaged</td><td>Major</td><td>Site or Loc</td><td>Medium Term</td><td>Medium</td><td>Definite</td><td>Medium</td><td>+ve/-ve</td><td>High</td></tr>
<tr><td rowspan="3">Management Measures</td><td colspan="9">Re-instaement of the stored soils onto areas of disturbance where infrastructure has been demolished and removed, and the attention to land form reclimation on areas where collapse at surface has caused ponding. A free draining landform is important to both soil and water quality.</td></tr>
<tr><td colspan="9">Contour and stabilise slopes to be free draining</td></tr>
<tr><td colspan="9">Cultivate, amelioration and oxygenation of growing medium, the planting of required vegetative cover and irrigation if required, will reduce/mange erosion, decrease compaction and stabilise the land form. This will once cover has been obtained, effectivily see the sites returned to a grazing land capability rating.</td></tr>
<tr><td rowspan="2">After management</td><td>Management</td><td>Magnitude</td><td>Spatial Scale</td><td>Duration</td><td>Consequence</td><td>Probability</td><td>Significance</td><td>Pos/Neg</td><td>Conf. Level</td></tr>
<tr><td>Managed</td><td>Moderate</td><td>Site</td><td>Medium Term</td><td>Medium</td><td>Possible</td><td>Low</td><td>+ve/-ve</td><td>Medium</td></tr>
</table>

Table 5.2.4.1 Decommissioning Phase – Impact Significance – Phase 1 Stooping Project

CLOSURE/REHABILITATION PHASE									
Activity	Rehabilitation of surface impacts associated with mining.								
Project Phase	Closure/Rehabilitation								
Impact Summary	Net Loss of soil volume and utilisation potential due to change in material status (physical and chemical) and loss of nutrient base (de-nutrification), potential for compaction, erosion and contamination, while reinstatement will increase the footprint of rehabilitated grazing land potential.								
Potential Impact Rating	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Unmanaged	Major	Site or Loc	Medium Term	Medium	Definite	**Medium**	+ve/-ve	High
Management Measures	Re-instaement of the stored soils onto areas of disturbance where infrastructure has been demolished and removed and where subsidence has occurred due to collapse of underground workings.								
	Contour and stabilise slopes to be free draining								
	Cultivate, amelioration and oxygenation of growing medium, the planting of required vegetative cover and irrigation if required, will reduce/mange erosion, decrease compaction and stabilise the land form. This will once cover has been obtained, effectivily see the sites returned to a grazing land capability rating.								
After management	**Management**	**Magnitude**	**Spatial Scale**	**Duration**	**Consequence**	**Probability**	**Significance**	**Pos/Neg**	**Conf. Level**
	Managed	Moderate	Site	Medium Term	Medium	Possible	**Low**	+ve/-ve	Medium

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1 General

In line with the Equator Principles (IFC Performance Principles), and the concept of good practice and sustainability, it is incumbent on any developer to not only assess and understand the possible impacts that a development might cause, but to also propose and table management measures that will aid in minimising and where possible mitigate the effects.

The management of the natural resources (soils, land use and land capability) have been assessed on a phase basis (preconstruction, construction, operation and decommissioning/closure) in keeping with the impact assessment (EIA) philosophy, while the Environmental Management Plan (EMP) has been designed as a working plan and utilisation guide for soil and land management.

The results tabled are based on the site specific soil characterisation and classification in conjunction with the geomorphology (topography, altitude, attitude, climate and ground roughness) of the sites that will be impacted or affected.

The plan gives recommendations on the handling of the soils throughout the life of the development along with recommendations for the utilisation of the soils for rehabilitation and management of affected areas.

It has been assumed that the areas that were affected will be returned to as close as possible their pre-construction state (topographic levels, wilderness/conservation or low intensity grazing status – Refer to the Chamber of Mines Land Classification System (Refer to Section 2 - Table 2.2.1 of the Baseline Study).

The concept of soil management and effective utilisation of any/all “Utilisable” soil is recommended as a minimum requirement and as part of the overall Soil Utilisation Philosophy.

In terms of the “Minimum Requirements”, **usable or utilisable soil** is defined here as all soil above an agreed subterranean cut-off depth defined by the project soil scientist, and will vary for different forms of soil encountered in a project area and the type of project being considered. It does not differentiate between topsoil (orthic horizon) and other subsoil horizons necessarily.

The following soil utilisation guidelines **(*all be they generic*)** should be adhered to wherever possible:

- Over areas of deep excavation (Mining or Deep excavations/foundations where the majority or all of the soil profile is to be impacted) *strip all usable soil* as defined (700mm) in terms of the soil classification and stockpile as berms or low, terraced dumps. Alluvial soils should be stockpiled separately from the colluvial (shallower) and in-situ derived materials, which in turn should be stored separately from any calcrete material, while the soft overburden is stored as a separate unit, as a defined dump of less than 15m in height preferably.

  Protect from contamination and erosion by rock cladding or vegetation cover and adequate drainage of surface runoff.

  At *rehabilitation* replace the soft overburden followed by the ferricrete/calcrete, compact the substrate followed by the replacement of the utilisable soil to appropriate soil depths, landscape the terrain to achieve an appropriate topographic aspect and attitude to achieve a free draining landscape as close as possible the pre-mining/construction land capability rating.

Before *rehabilitation* remove all gravel and other rocky material and recycle as construction material or place in open voids. Remove foundations to a maximum depth of 1m. Replace soil to appropriate soil depths and in appropriate topographic position so as to achieve pre-mining land capability. Protect the stored materials from erosion and contamination using vegetation or rock cladding.

6.2 Pre-construction and Construction Phase

Rehabilitation will not only save significant costs at closure, but will ensure that additional impacts to the environment are reduced.

The depths of utilisable materials vary between 300mm and greater than 1,500mm.

Due to the shallow soil depths on the more rocky areas it is recommended that sufficient materials are removed from the areas were adequate soil depths are present and do exist, so that the shallow areas can be adequately resorted during rehabilitation and at closure.

For the Decline Adit and Portals to the underground workings, ventilation shafts and associated complex of infrastructure associated with the stooping projects (Phase 1 and 2), the nature of the activities that will take place and the infrastructure that is to be constructed (Heavy industry and machinery) it is recommended that at least 750mm of soil should be removed/stripped wherever possible.

The conveyencing route and access roads/ways will require that 500mm of soil is removed and stored where possible and available.

The areas confirmed as low sensitivity and or outside of the “No Go” zones are sufficiently similar in character that they can be stored as one soil group (Refer to Figure 3 – Soil Sensitivity Map). However, the Highly Sensitive and “No Go” areas (shallow soils and wetland areas) should not be impacted unless absolutely necessary, and then only if the necessary permissions have been obtained (licenses etc.). The ferricrete described as part of the baseline study are part of the more sensitive sites mapped, and wherever possible these layers should have been stripped and stored separately from the utilisable topsoil and underlying soft rock if they are disturbed.

Table 6.2 describes the proposed utilisation of the soils during the preconstruction and construction phase.

Table 6.2 Construction Phase – Soil Utilisation Plan

Phase	Step	Factors to Consider	Comments
Construction	Delineation of areas to be stripped		Stripping will only occur where soils are to be disturbed by activities that are described in the design report, and where a clearly defined end rehabilitation use for the stripped soil has been identified.
	Reference to biodiversity action plan		It is recommened that all vegetation is stripped and stored as part of the utilizable soil. However, the requirements for moving and preserving fauna and flora according to the biodiversity action plan should be consulted.
	Stripping and Handling of soils	Handling	Soils will be handled in dry weather conditions so as to cause as little compaction as possible. Utilizable soil (Topsoil and upper portion of subsoil B2/1) must be removed and stockpiled separately from the lower "B" horizon, with the ferricrete layer being seperated from the soft/decomposed rock, and wet based soils seperated from the dry soils if they are to be impacted.
		Stripping	The "Utilizable" soil will be stripped to a depth of 750mm or until hard rock/ferricrete is encountered. These soils will be stockpiled together with any vegetation cover present (only large vegetation to be removed prior to stripping). The total stripped depth should be 750mm, wherever possible.
	Delineation of Stockpiling areas	Location	Stockpiling areas will be identified in close proximity to the source of the soil to limit handling and to promote reuse of soils in the correct areas. All stockpiles will be founded on stabilized and well engineered "pads"
		Designation of Areas	Soils stockpiles will be demarcated, and clearly marked to identify both the soil type and the intended area of rehabilitation.

This "Soil Utilisation Plan" is intimately linked to the "development plan", and it should be understood that if the plan of construction changes, these recommendations will probably have to change as well.

6.3 Operational Phase

The operational phase will see very little change in the development requirements, with the footprint of disturbance remaining constant for these areas. Areas that are being undermined and where stooping occurs will potentially collapse and the topographic levels at surface will be change. The probability of cracking and the ponding of water within the altered landform will result.

Maintenance and the care of the soil and land resources will be the main management activity and objective required during the operational phase. Management of material loss, compact and contamination due to salinisation are the main issues of consideration. Table 6.3 details recommendations for the care and maintenance of the resource during the operational phase.

The semi-arid climate and unique character of the soils in these areas require that the site specific and unique natural phenomena should be used to the advantage of the project.

Working with or on the differing soil materials (all of which occur within the areas that are to be disturbed) will require better than average management and careful planning if rehabilitation is to be successful, and it is important that the sensitive and highly sensitive materials are avoided wherever possible.

Cracking and the development of ponded areas within the landform will result in poor quality water standing and the potential for saline water ingress into the vadose zone and fractured rock aquifer below.

Table 6.3 Operational Phase – Soil Conservation Plan

Phase	Step	Factors to Consider	Comments
Operation	Stockpile management	Vegetation establishment and erosion control	Enhanced growth of vegetation on the Soil Stockpiles and berms will be promoted (e.g. by means of watering and/or fertilisation), or a system of rock cladding will be employed. The purpose of this exercise will be to protect the soils and combat erosion by water and wind.
		Storm Water Control	Stockpiles will be established/engineered with storm water diversion berms in place to prevent run off erosion.
		Stockpile Height and Slope Stability	Soil stockpile and berm heights will be restricted where possible to <1.5m so as to avoid compaction and damage to the soil seed pool. Where stockpiles higher than 1.5m cannot be avoided, these will be benched to a maximum height of 15m. Each bench should ideally be 1.5m high and 2m wide. For storage periods greater than 3 years, vegetative (vetiver hedges and native grass species - refer to Appendix 1) or rock cover will be essential, and should be encouraged using fertilization and induced seeding with water and/or the placement of waste rock. The stockpile side slopes should be stabilized at a slope of 1 in 6. This will promote vegetation growth and reduce run-off related erosion.
		Waste	Only inert waste rock material will be placed on the soil stockpiles if the vegetative growth is impractical or not viable (due to lack of water for irrigation etc.). This will aid in protecting the stockpiles from wind and water erosion until the natural vegetative cover can take effect.
		Vehicles	Equipment, human and animal movement on the soil stockpiles will be limited to avoid topsoil compaction and subsequent damage to the soils and seedbank.

6.4 Decommissioning and Closure

The decommissioning and closure phase will see:

- The backfilling of all voids and any subsidence and the reconstruction of the required barrier layer (compaction of ferricrete and clay rich materials) wherever feasible and possible;
- Topdressing of the disturbed and backfilled areas with the stored “utilisable” soil ready for re-vegetation;
- Fertilization and stabilization of the backfilled materials and final cover materials (soil and vegetation) and
- The landscaping of the replaced soils to be free draining.

There will be a positive impact on the soil and land capability environments as the area of disturbance is reduced, and the soils are returned to a state that can support low intensity wildlife grazing or sustainable conservation.

Table 6.4 is a summary of the proposed management and mitigation actions recommended.

Table 6.4 Decommissioning and Closure Phase – Soil Conservation Plan

Phase	Step	Factors to Consider	Comments
Decommissioning & Closure	Rehabilitation of Disturbed land & Restoration of Soil Utilization	Placement of Soils	Rehabilitation of all/any disturbed sites either ongoing as disturbed areas become available for rehabilitation and/or at closure. The utilizable soil (500mm to 750mm) will need to be redistributed in a manner that achieves an approximate uniform stable thickness consistent with the approved post development end land use (Conservation land capability and/or Low intensity grazing), and will attain a free draining surface profile. A minimum layer of 300mm of soil will be replaced.
		Fertilization	A representative sampling of the stripped and stockpiled soils will be analysed to determine the nutrient status and chemistry of the utilizable materials. As a minimum the following elements will be tested for: EC, CEC, pH, Ca, Mg, K, Na, P, Zn, Clay% and Organic Carbon. These elements provide the basis for determining the fertility of soil. based on the analysis, fertilisers will be applied if necessary.
		Erosion Control	Erosion control measures will be implemented to ensure that the soil is not washed away and that erosion gulleys do not develop prior to vegetation establishment.
	Pollution of Soils	In-situ Remediation	If soil (whether stockpiled or in its undisturbed natural state) is polluted, the first management priority is to treat the pollution by means of in situ bioremediation. The acceptability of this option must be verified by an appropriate soils expert and by the local water authority on a case by case basis, before it is implemented.
		Off site disposal of soils.	If in situ treatment is not possible or acceptable then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (Local Dept of Water Affairs) and disposed of at an appropriate, permitted, off-site waste facility.

6.5 Monitoring and Maintenance

Nutrient requirements reported herein are based on the monitoring and sampling of the soils at the time of the baseline survey. These values will definitely alter during the storage stage and will need to be re-evaluated before being used during rehabilitation. Ongoing evaluation of the nutrient status of the growth medium will be needed throughout the life of the project and into the rehabilitation phase.

During the rehabilitation exercise preliminary soil quality monitoring should be carried out to accurately determine the fertiliser requirements that will be needed. Additional soil sampling should also be carried out annually until the levels of nutrients, specifically magnesium, phosphorus and potassium, are at the required levels for sustainable growth. Once the desired nutritional status has been achieved, it is recommended that the interval between sampling is increased. An annual environmental audit should be undertaken. If growth problems develop, ad hoc, sampling should be carried out to determine the problem.

Monitoring should always be carried out at the same time of the year and at least six weeks after the last application of fertiliser.

Soils should be sampled and analysed for the following parameters:

pH (H_2O)	Phosphorus (Bray I)	
Electrical conductivity	Calcium mg/kg	
Cation exchange capacity	Sodium mg/kg;	
Magnesium mg/kg;	Potassium mg/kg	Zinc mg/kg;
Clay	Organic matter content (C %)	

The following maintenance is recommended:

- The area must be fenced, and all animals kept off the area until the vegetation is self-sustaining;
- Newly seeded/planted areas must be protected against compaction and erosion (Vetiver hedges etc.);
- Traffic should be limited were possible while the vegetation is establishing itself;
- Plants should be watered and weeded as required on a regular and managed basis were possible and practical;
- Check for pests and diseases at least once every two weeks and treat if necessary;
- Replace unhealthy or dead plant material;
- Fertilise, hydro seeded and grassed areas soon after germination, and
- Repair any damage caused by erosion.

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Van der Watt, H.v.H and Van Rooyen T. H, 1990. A glossary of soil science, Pretoria: Soil Science Society of South Africa (1990).

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APPENDIX 1

(SITE MAPS A3)

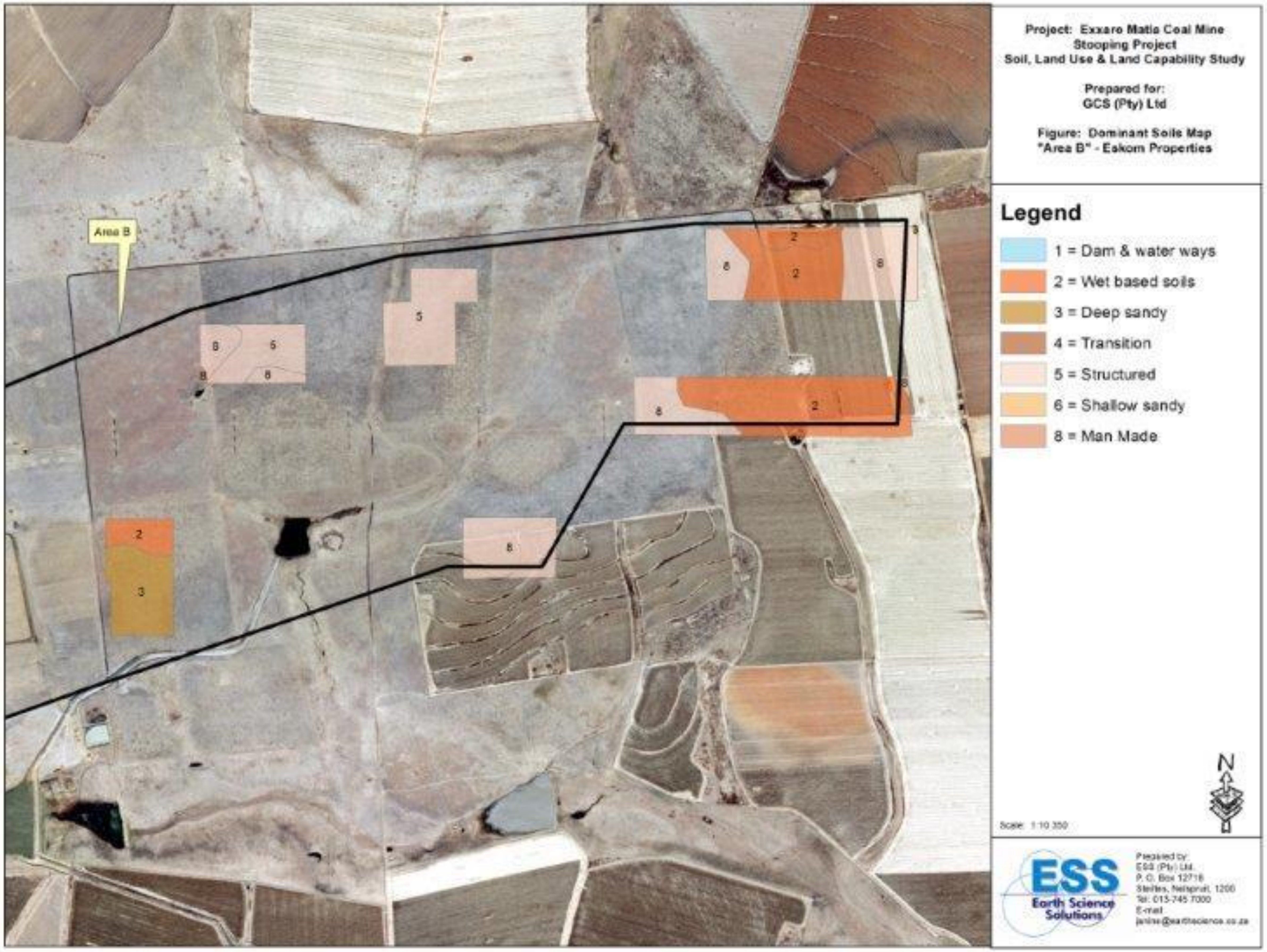
Phase 1 – Stooping Project

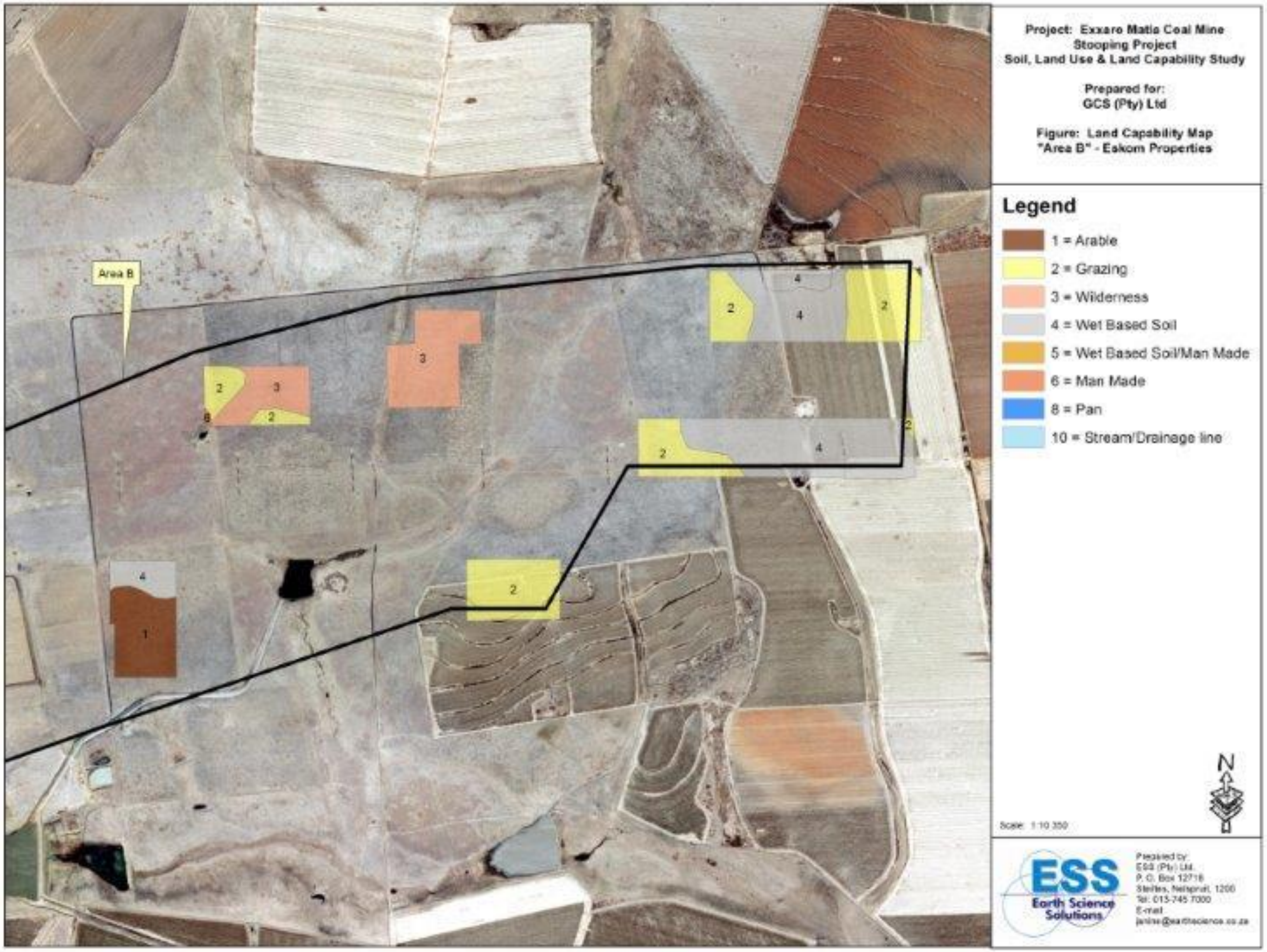
&

Phase 2 – Stooping Area Maps

(Dominant Soils, Land Capability, Land Use and Sensitivity Mapping)

PHASE 1


Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Area B" - Eskom Properties
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
8 = Man Made
Area B
N
ESS
Earth Science Solutions


Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
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GCS (Pty) Ltd
Figure: Land Capability Map "Area B" - Eskom Properties
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
8 = Pan
10 = Stream/Drainage line
Area B
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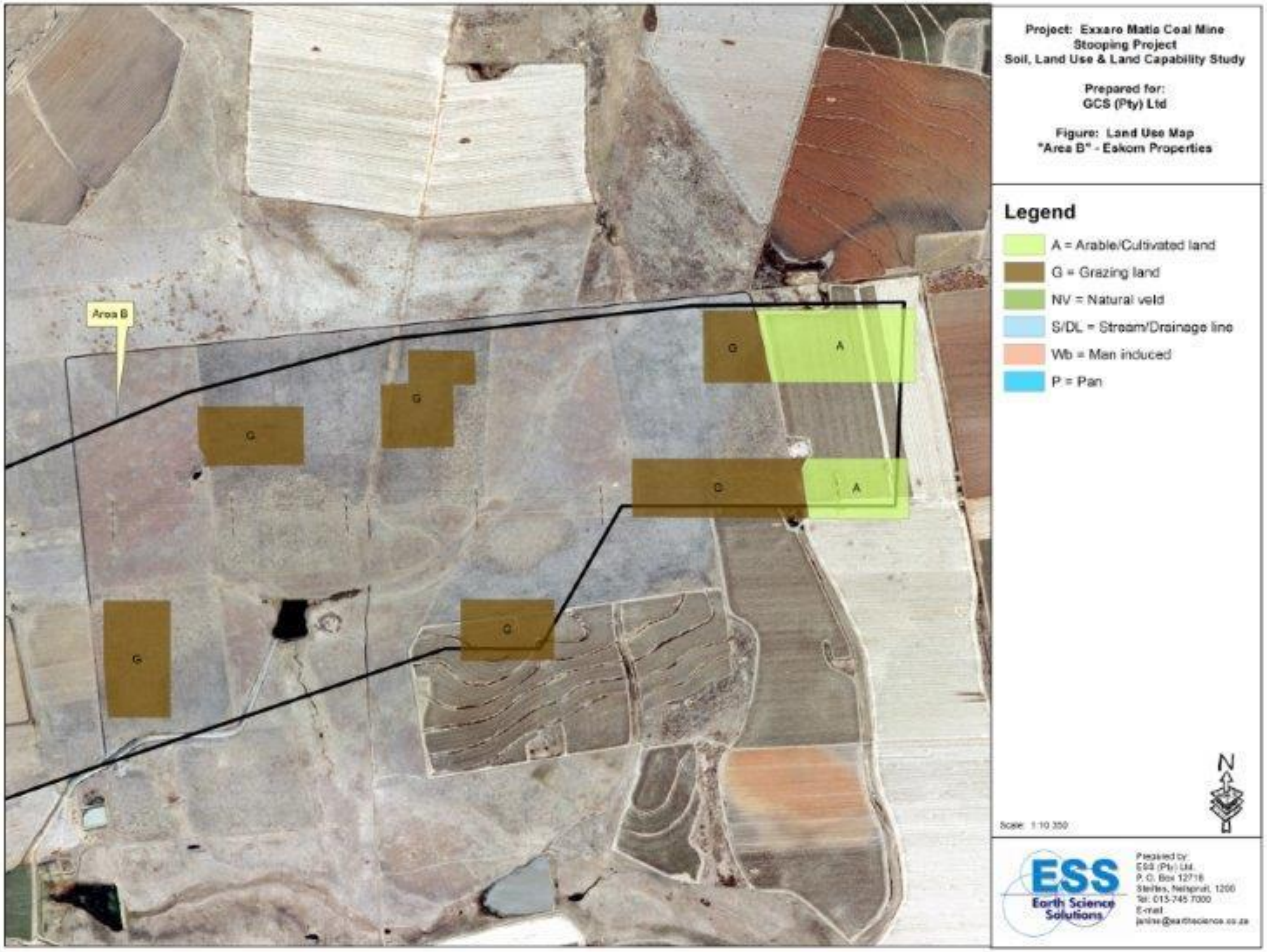
Scale: 1:10 350
ESS
Earth Science Solutions
P. O. Box 12716
Nelspruit, 1200
Tel: 013-745 7000
E-mail


Project: Exxaro Matla Coal Mine Stooping Project
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Prepared for:
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Figure: Land Use Map
"Area B" - Eskom Properties
Legend
A = Arable/Cultivated land
G = Grazing land
NV = Natural veld
S/DL = Stream/Drainage line
Wb = Man induced
P = Pan
Area B
G
A
N
Scale: 1:10 350
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janine@earthscience.co.za

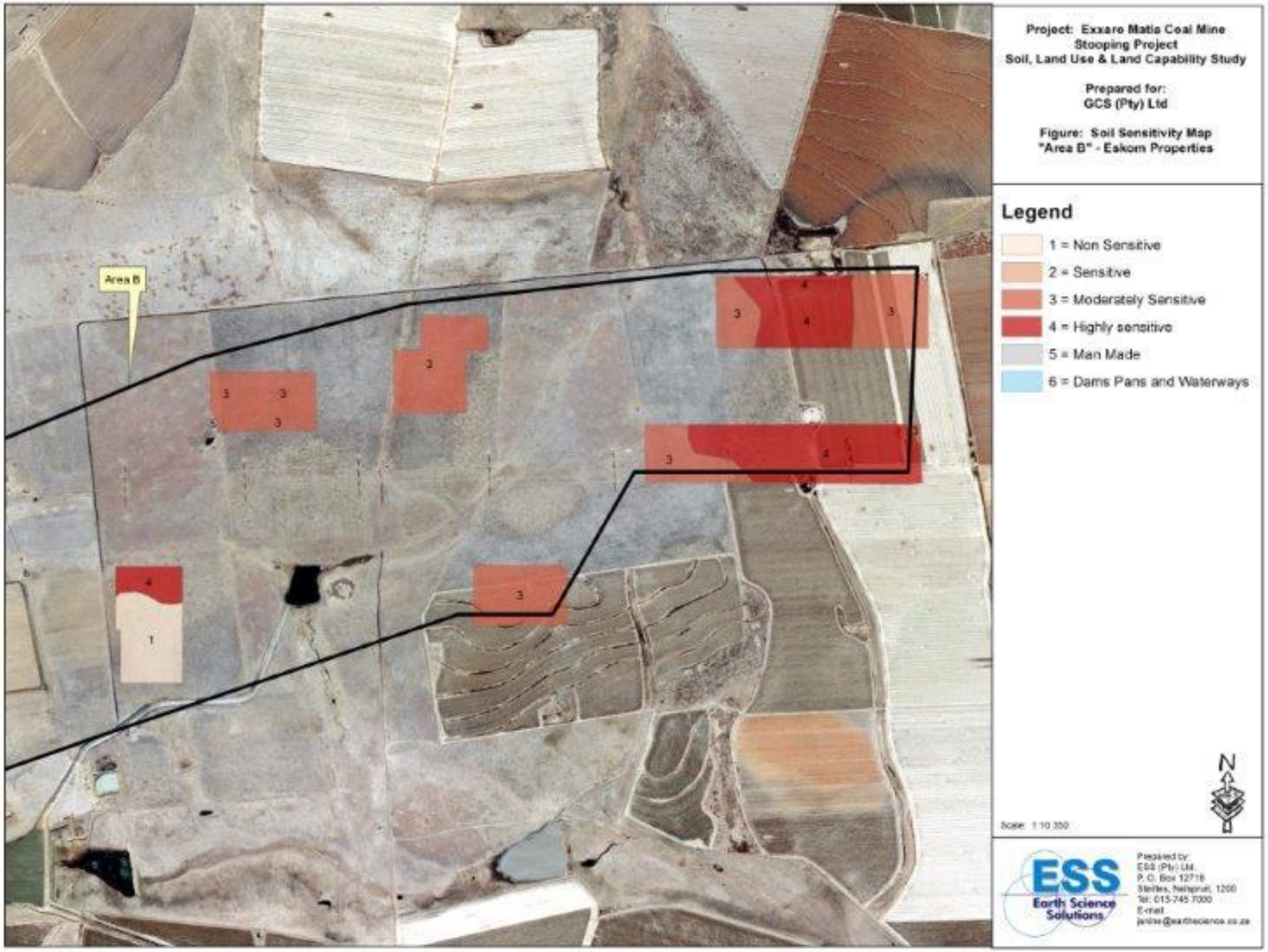
Project: Exxaro Matla Coal Mine Stooping Project
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Figure: Soil Sensitivity Map "Area B" - Eskom Properties
Legend
1 = Non Sensitive
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3 = Moderately Sensitive
4 = Highly sensitive
5 = Man Made
6 = Dams Pans and Waterways
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Scale: 1:10 350
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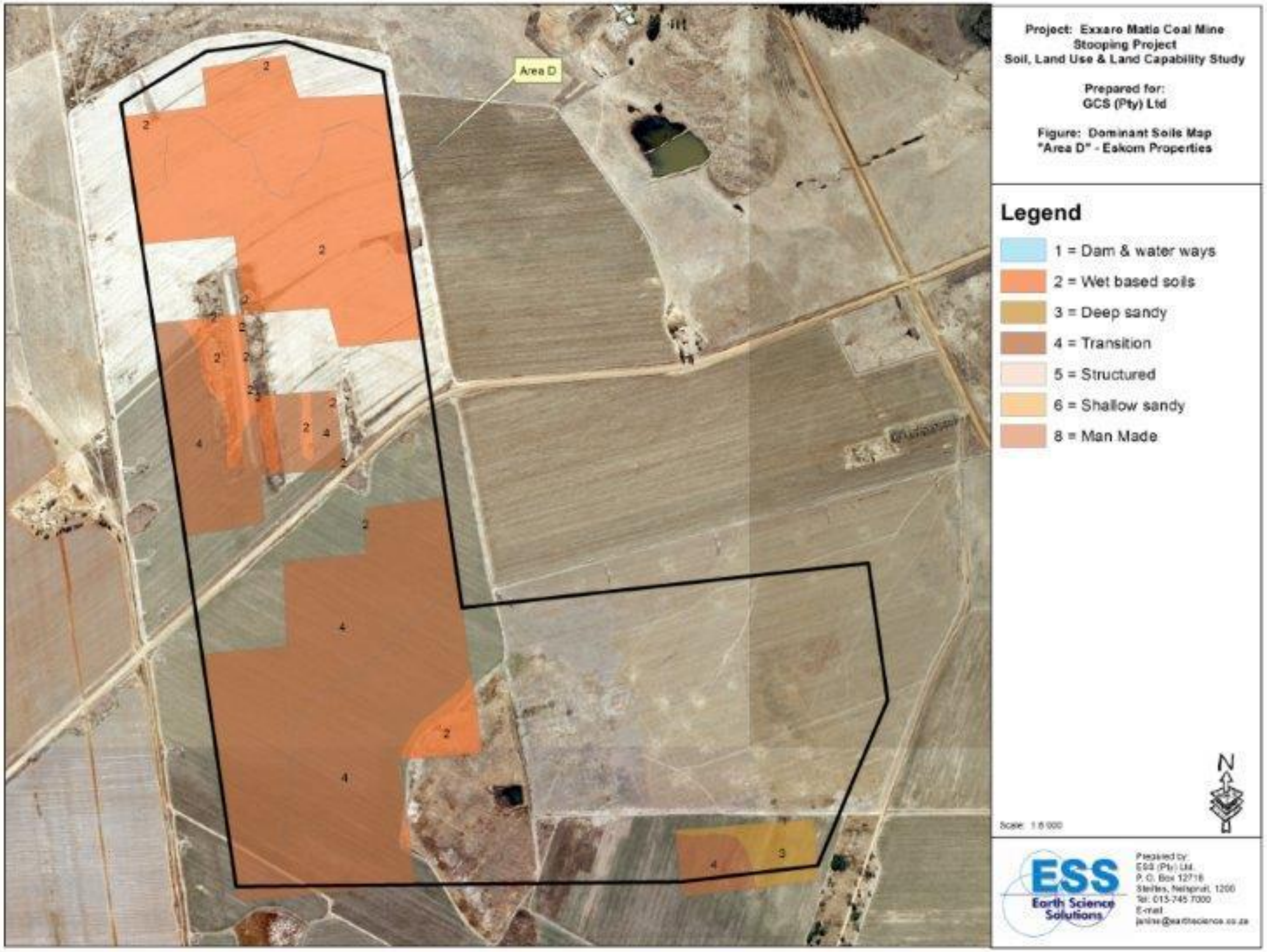
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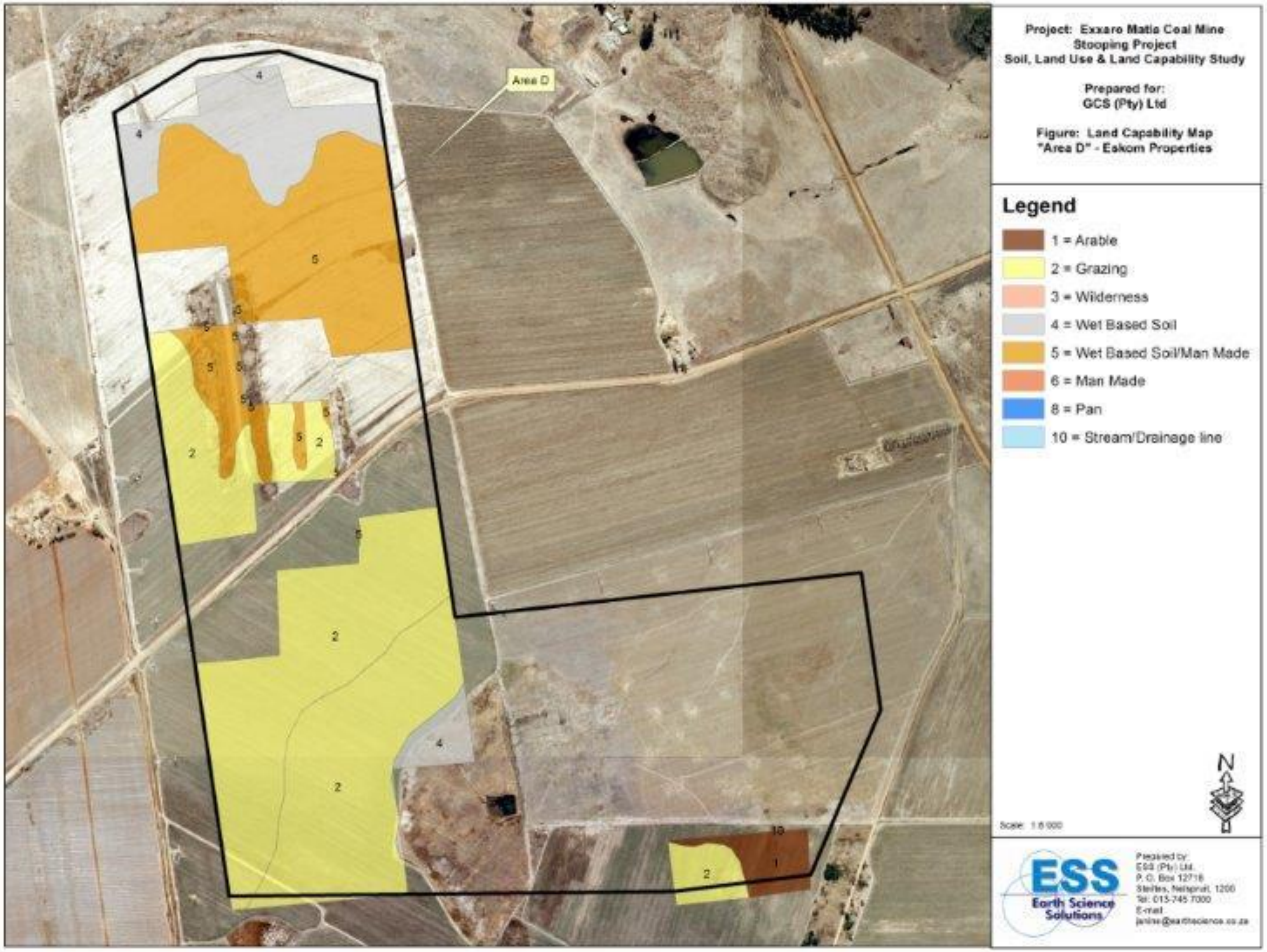
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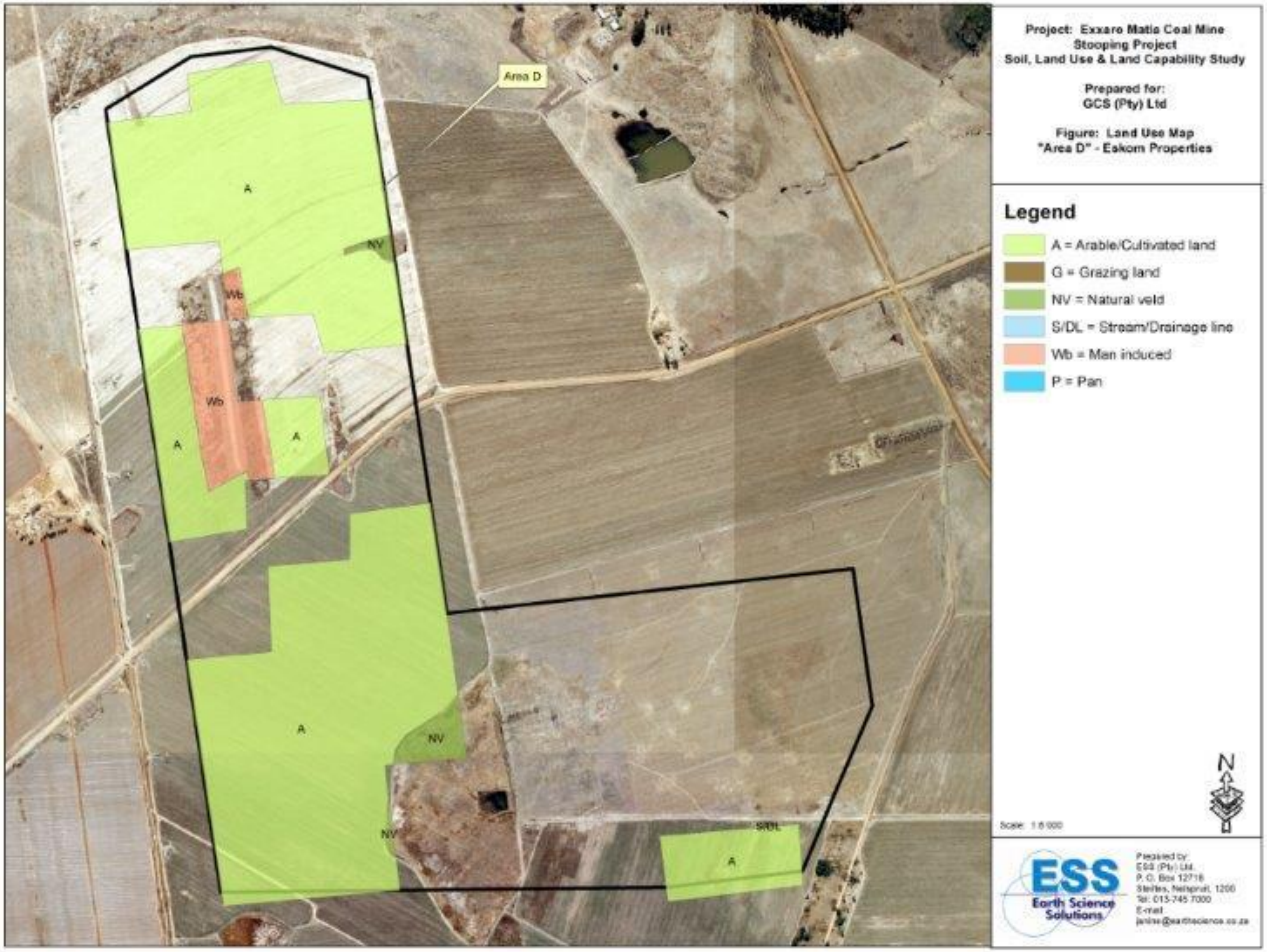
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N
Scale: 1:8 000
ESS
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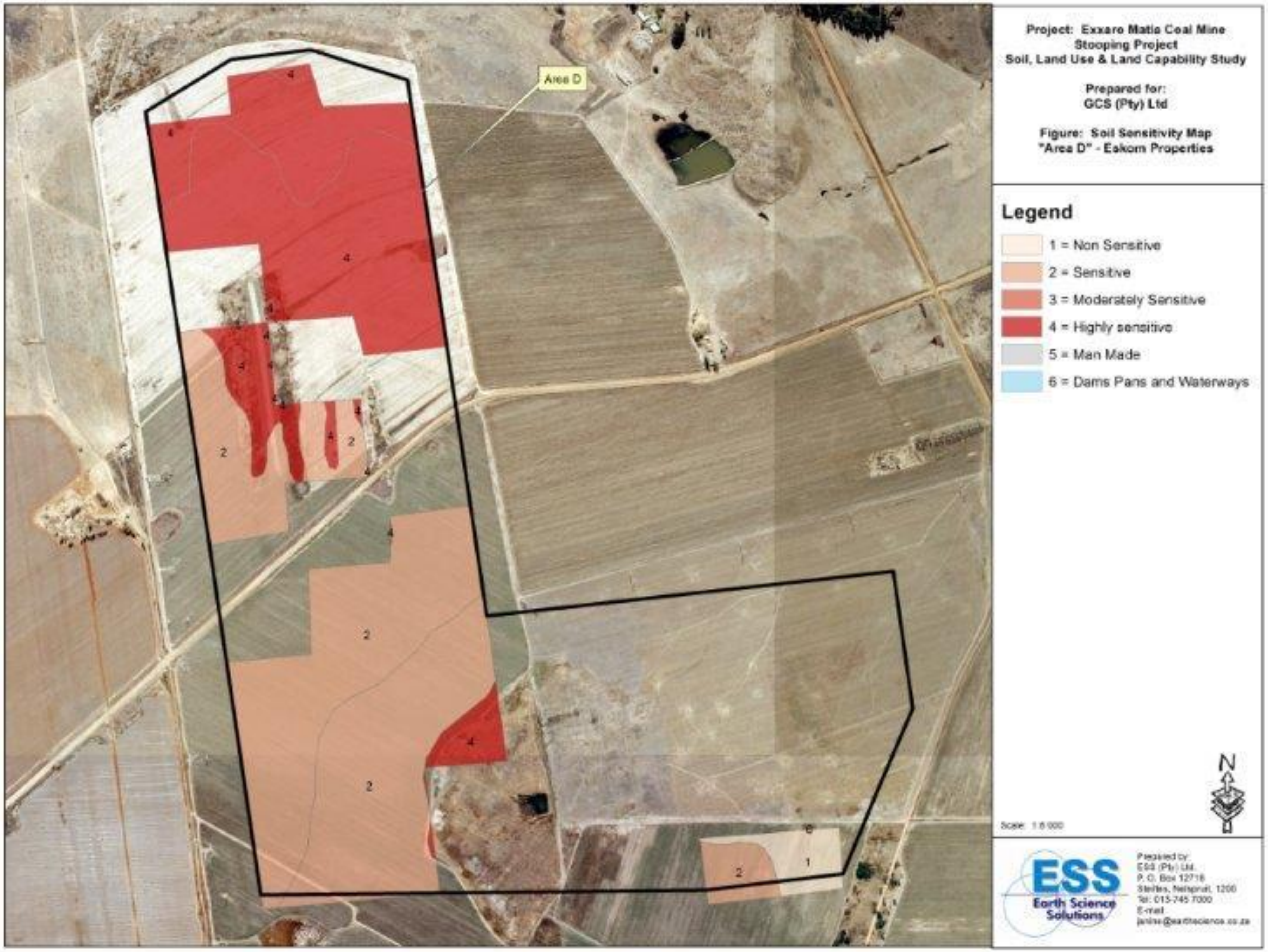
Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Soil Sensitivity Map
"Area D" - Eskom Properties
Legend
1 = Non Sensitive
2 = Sensitive
3 = Moderately Sensitive
4 = Highly sensitive
5 = Man Made
6 = Dams Pans and Waterways
Area D
N
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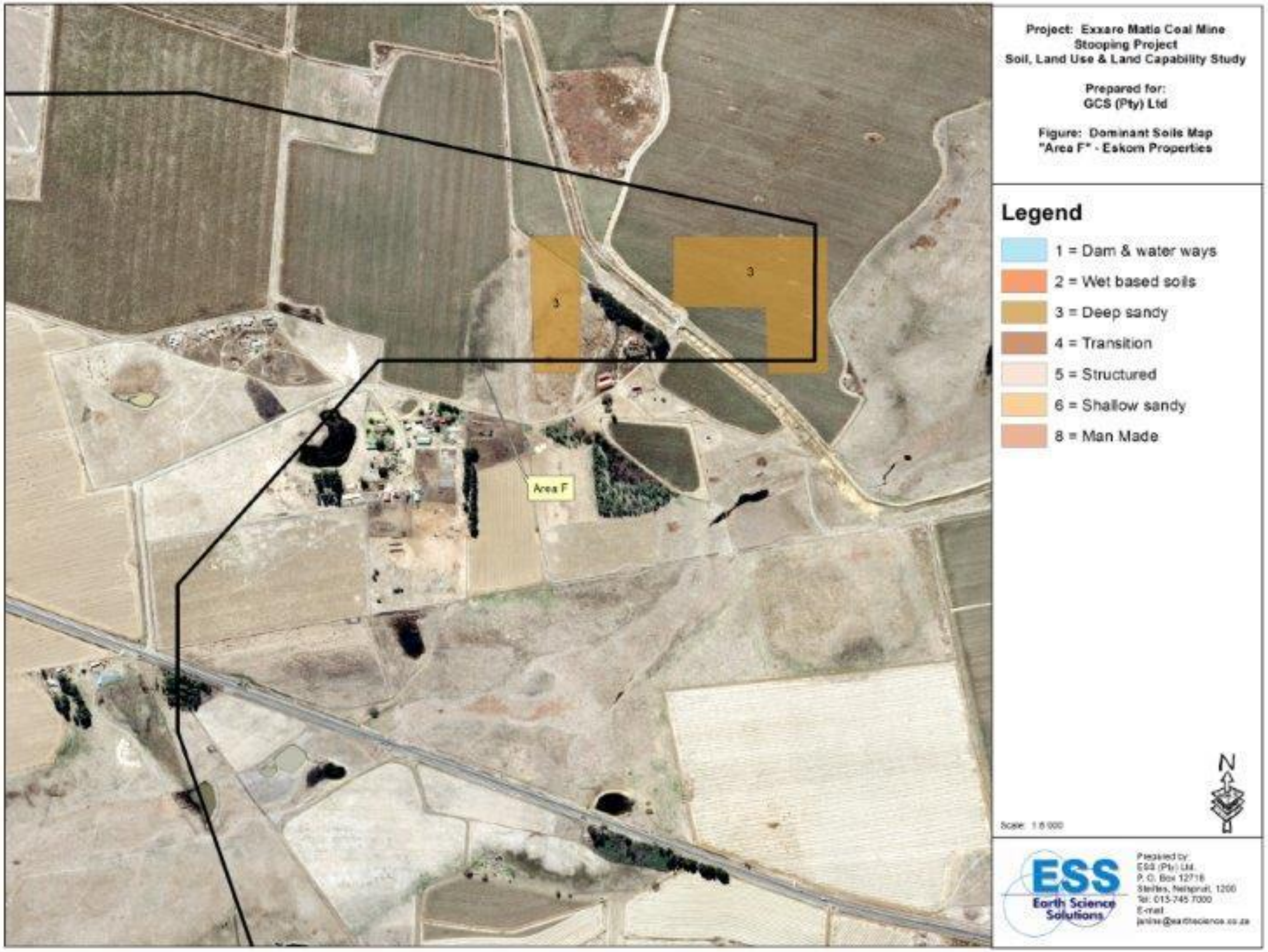
Project: Exxaro Matla Coal Mine
Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map
"Area F" - Eskom Properties
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
8 = Man Made
3
3
Area F
N
Scale: 1:6 000
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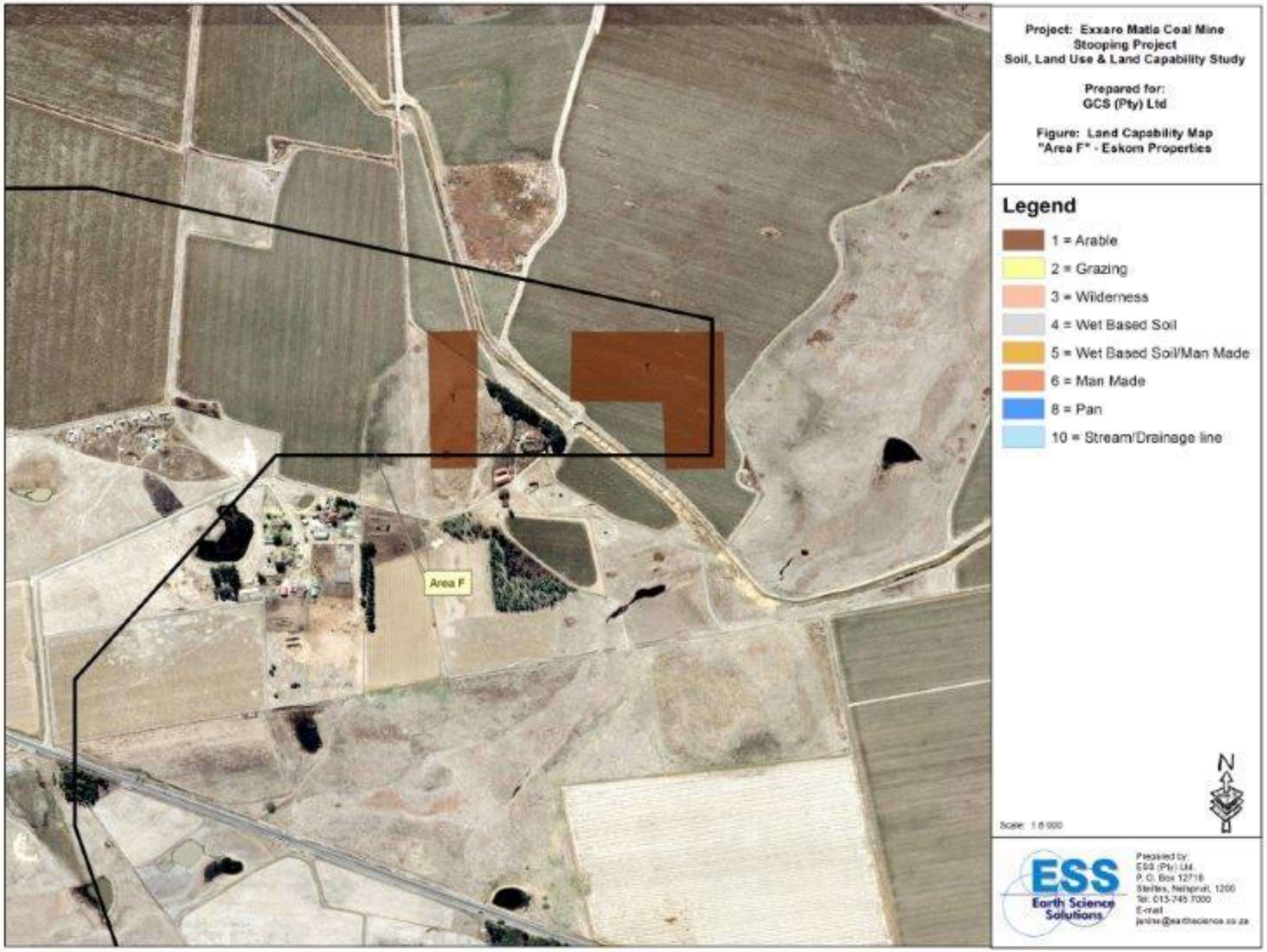
Project: Exxaro Matla Coal Mine
Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map
"Area F" - Eskom Properties
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
8 = Pan
10 = Stream/Drainage line
Area F
N
Scale: 1:6 000
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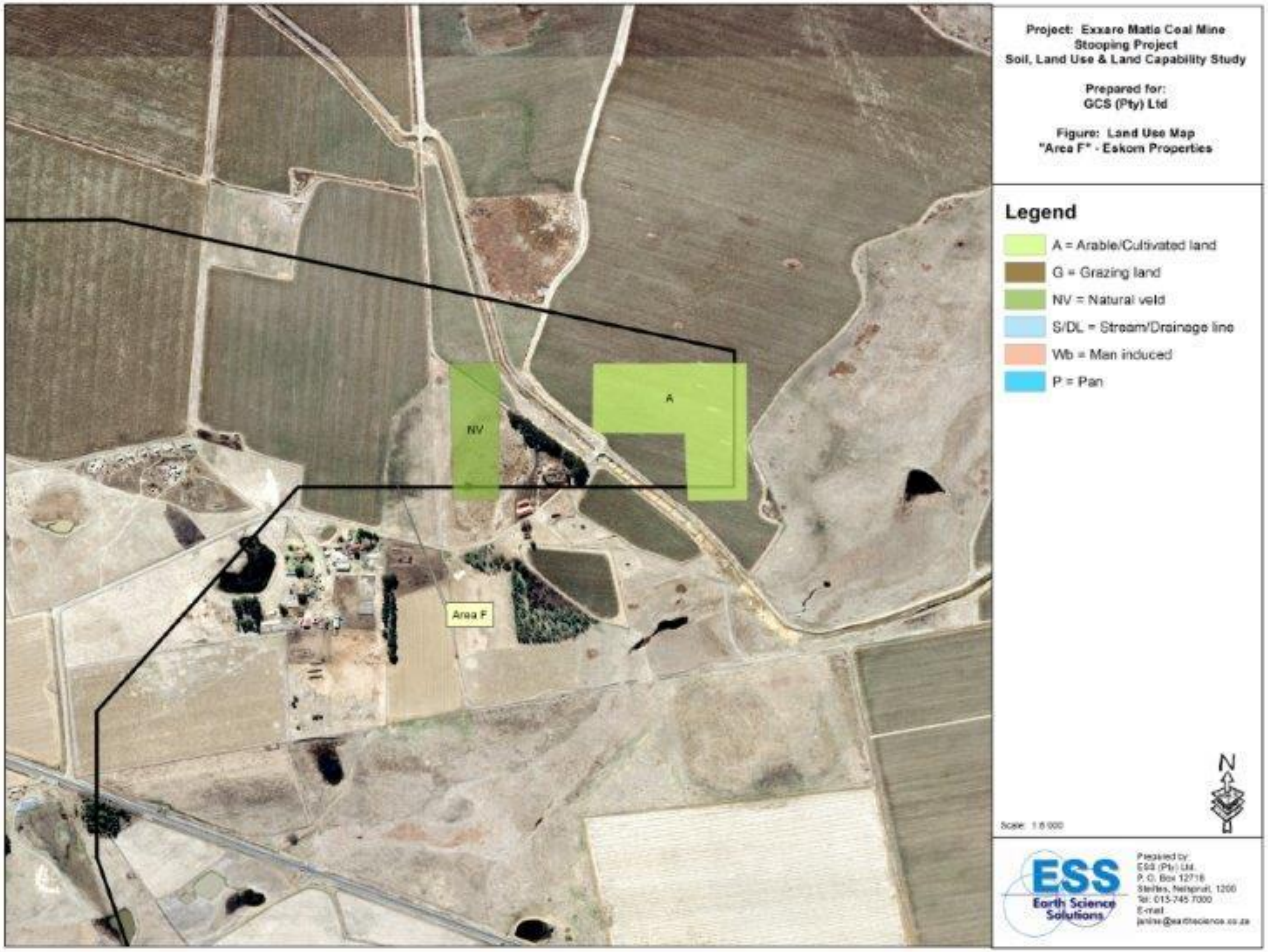
Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Use Map
"Area F" - Eskom Properties
Legend
A = Arable/Cultivated land
G = Grazing land
NV = Natural veld
S/DL = Stream/Drainage line
Wb = Man induced
P = Pan
NV
A
Area F
N
Scale: 1:8 000
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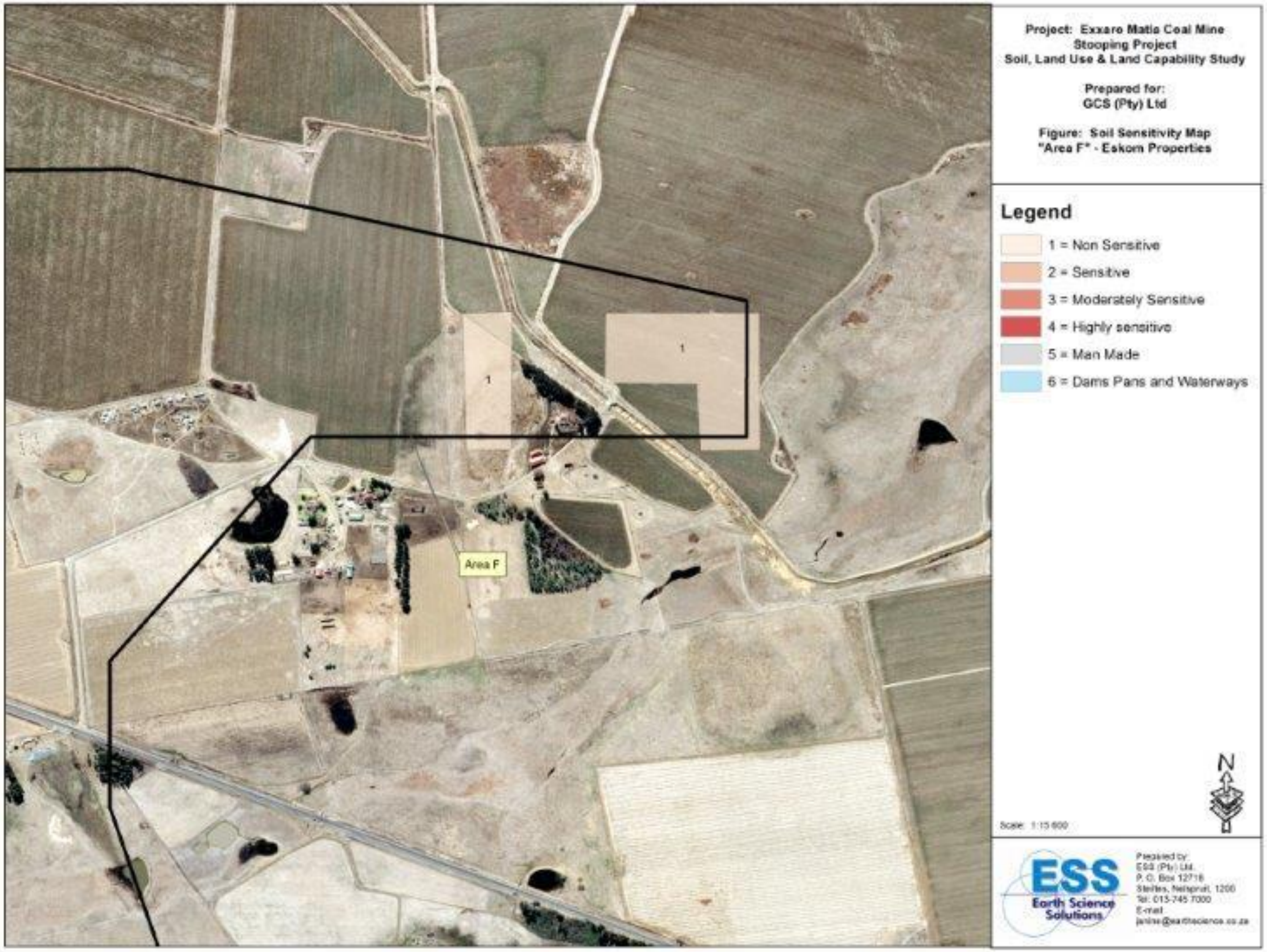
Project: Exxaro Matla Coal Mine
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Soil, Land Use & Land Capability Study
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Figure: Soil Sensitivity Map
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Legend
1 = Non Sensitive
2 = Sensitive
3 = Moderately Sensitive
4 = Highly sensitive
5 = Man Made
6 = Dams Pans and Waterways
1
1
Area F
N
Scale: 1:15 600
ESS
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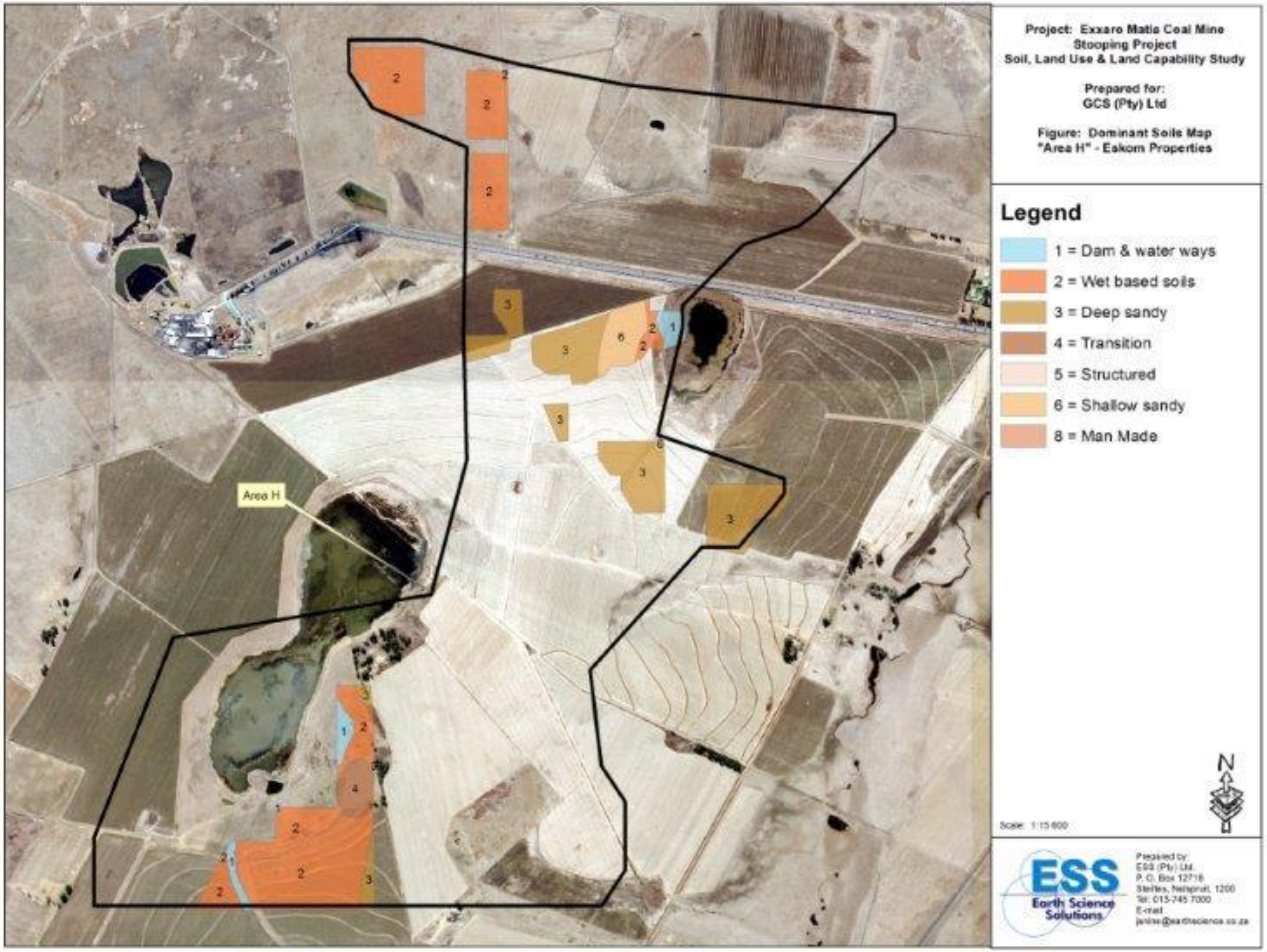
Project: Exxaro Matla Coal Mine
Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map
"Area H" - Eskom Properties
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
8 = Man Made
Area H
N
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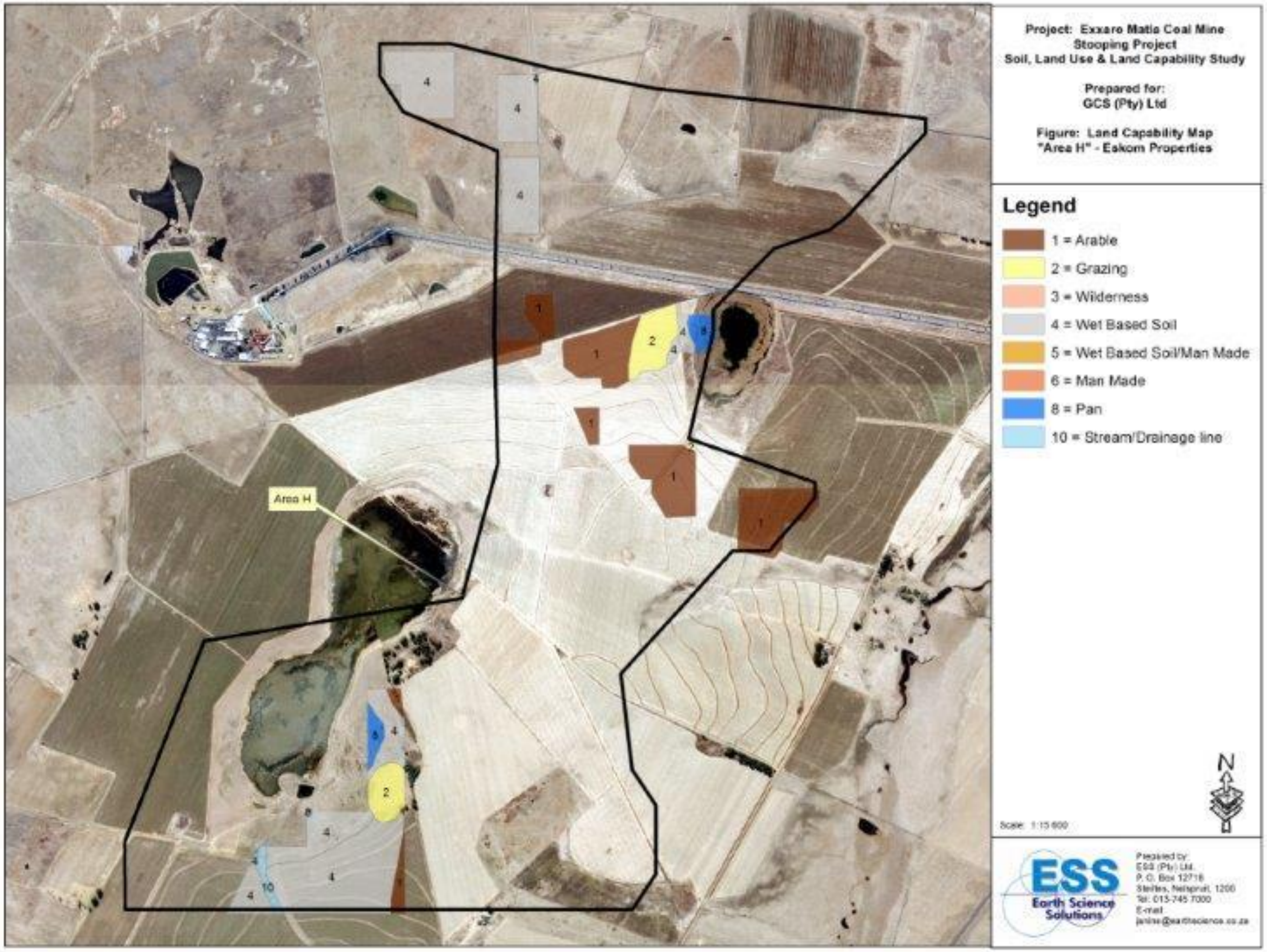
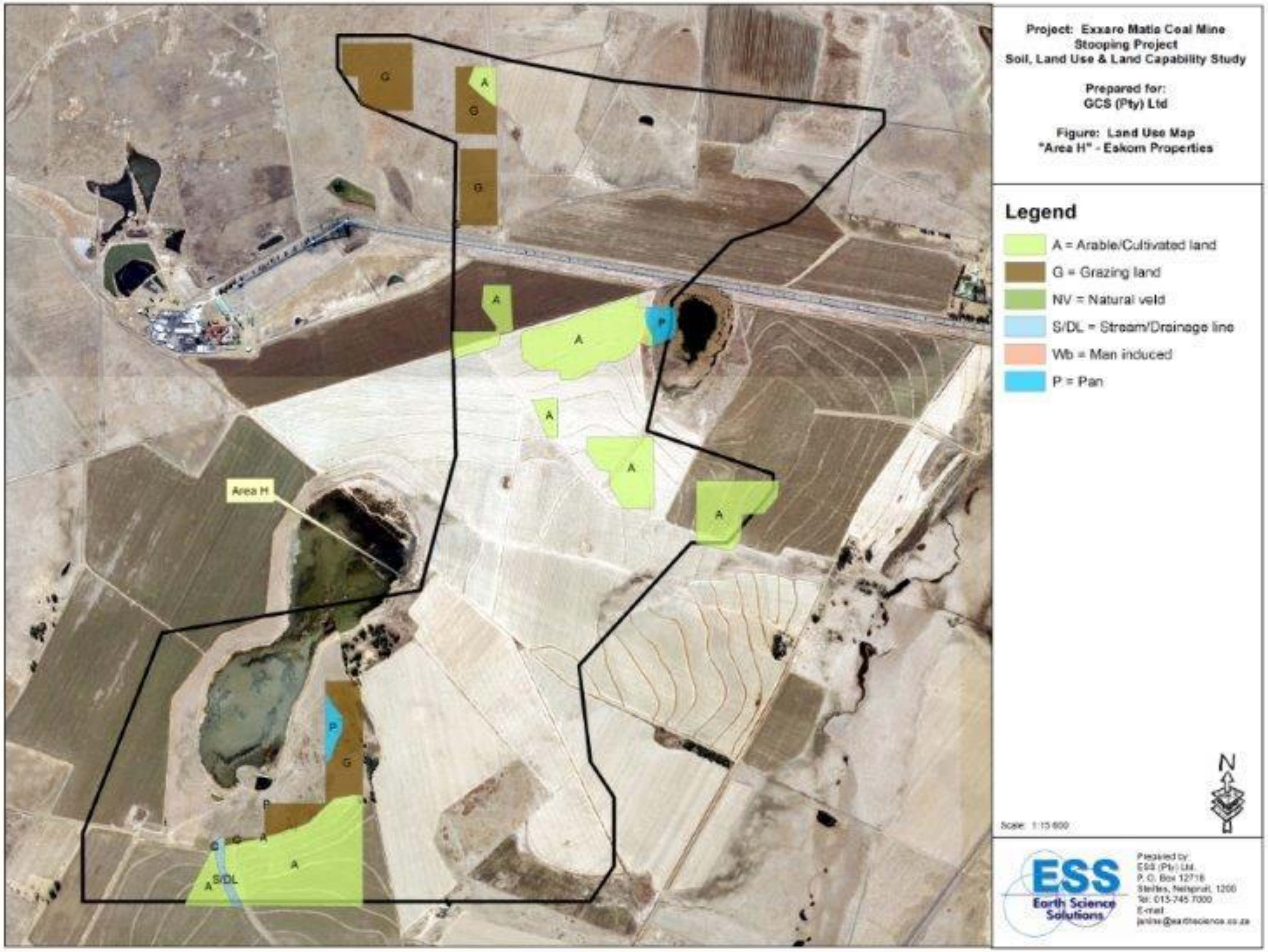

Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
Prepared for: GCS (Pty) Ltd
Figure: Land Capability Map "Area H" - Eskom Properties
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
8 = Pan
10 = Stream/Drainage line
Area H
Scale: 1:15 600
N


Project: Exxaro Matla Coal Mine
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Soil, Land Use & Land Capability Study
Prepared for:
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Figure: Land Use Map
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Legend
A = Arable/Cultivated land
G = Grazing land
NV = Natural veld
S/DL = Stream/Drainage line
Wb = Man induced
P = Pan
Area H
A
G
P
S/DL
N
Scale: 1:15 600
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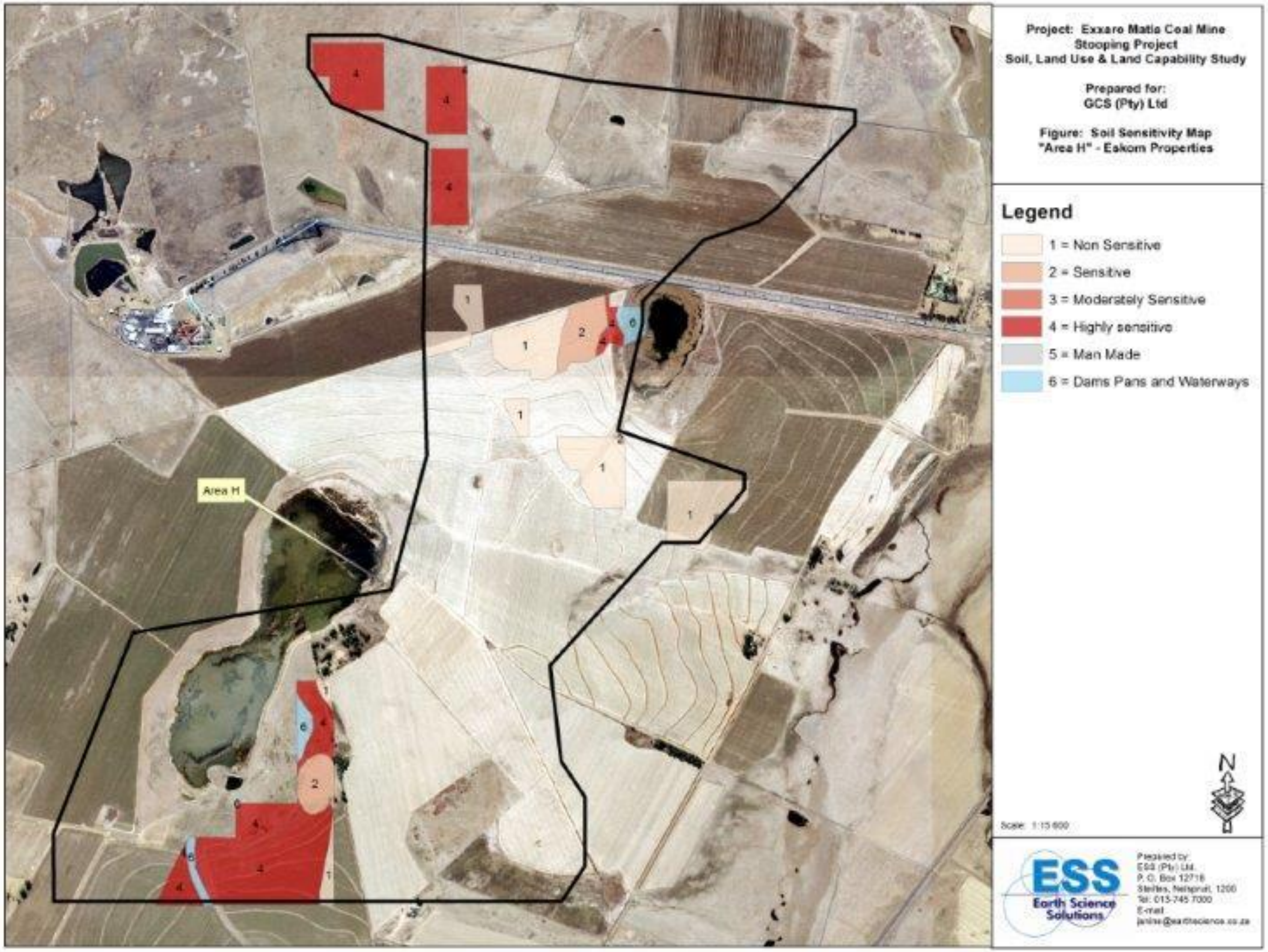
Project: Exxaro Matla Coal Mine
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Soil, Land Use & Land Capability Study
Prepared for:
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Figure: Soil Sensitivity Map
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1 = Non Sensitive
2 = Sensitive
3 = Moderately Sensitive
4 = Highly sensitive
5 = Man Made
6 = Dams Pans and Waterways
Area H
N
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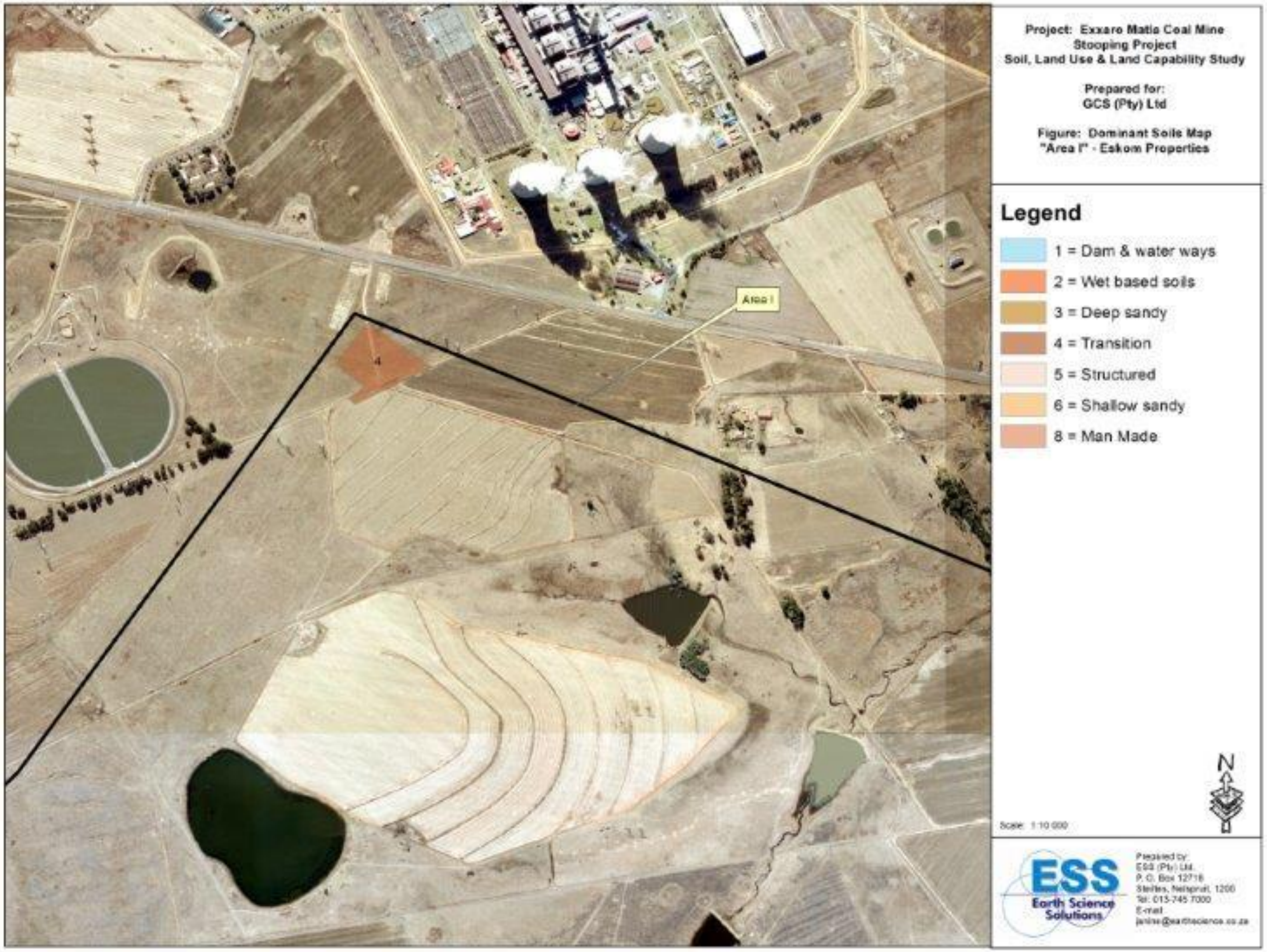
Project: Exxaro Matla Coal Mine Stooping Project
Soil, Land Use & Land Capability Study
Prepared for:
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Figure: Dominant Soils Map "Area I" - Eskom Properties
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
8 = Man Made
Area I
4
N
Scale: 1:10 000
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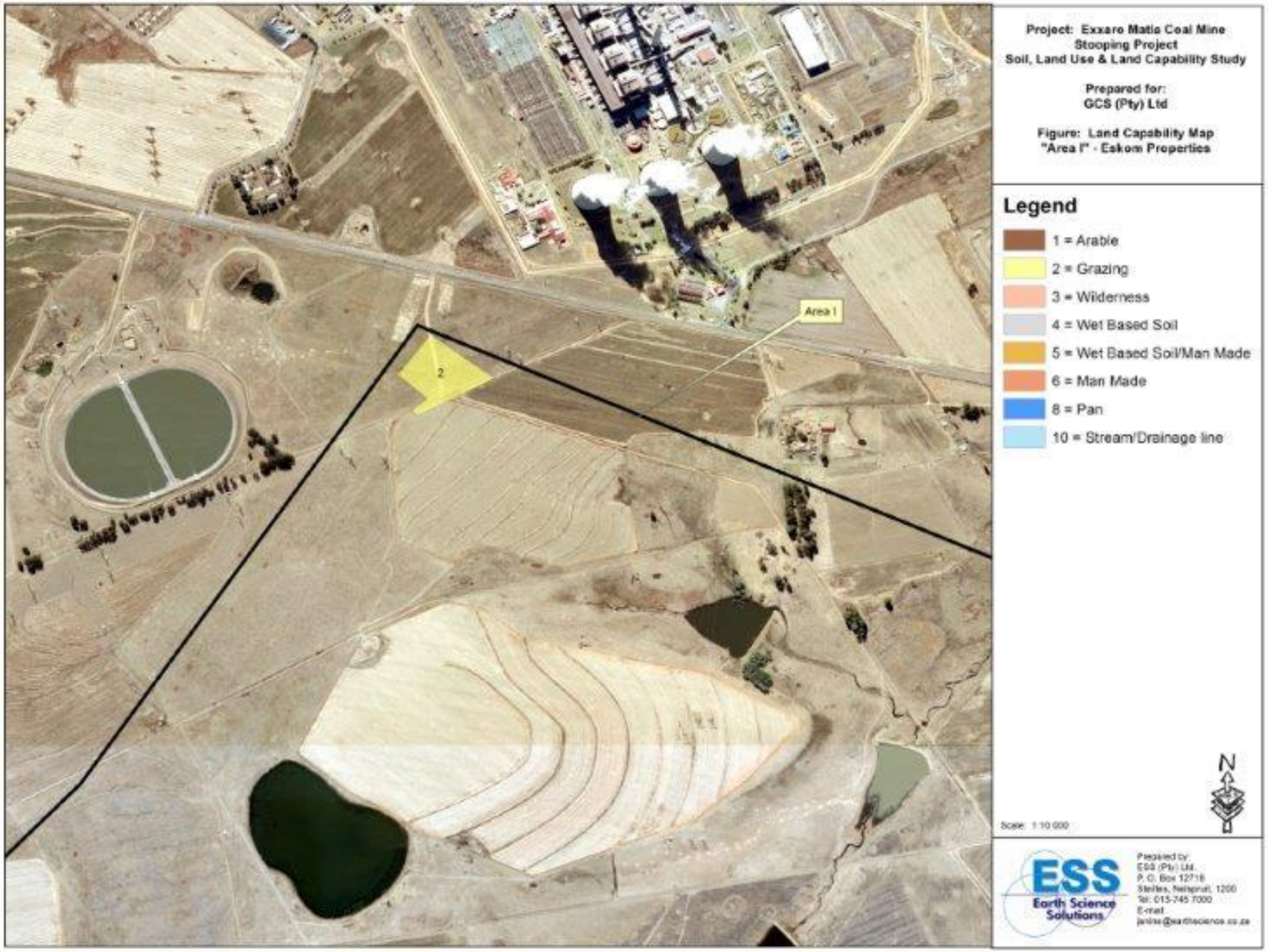
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Figure: Land Capability Map
"Area I" - Eskom Properties
Legend
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2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
8 = Pan
10 = Stream/Drainage line
Area I
2
N
Scale: 1:10 000
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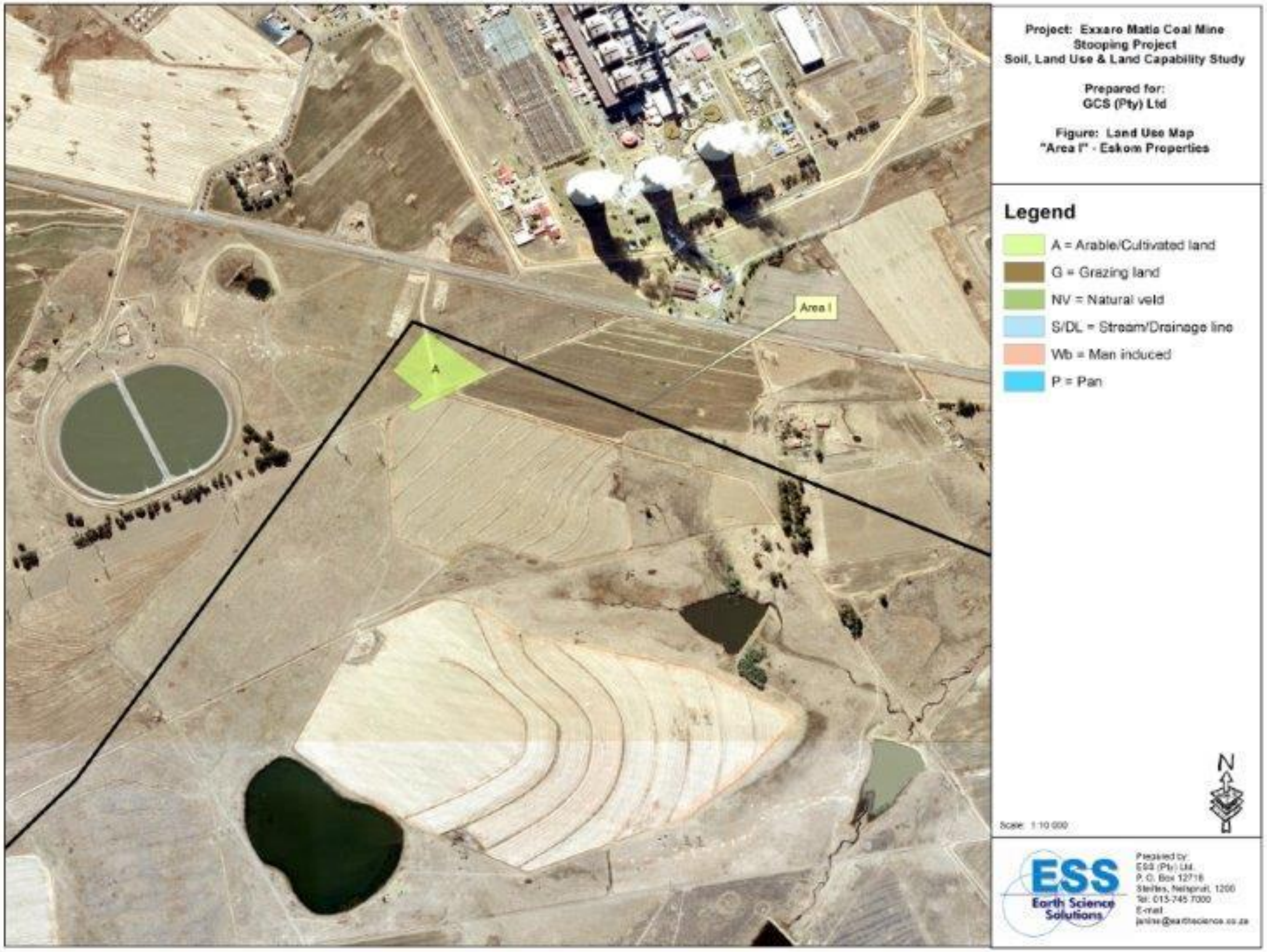
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NV = Natural veld
S/DL = Stream/Drainage line
Wb = Man induced
P = Pan
Area I
A
N
Scale: 1:10 000
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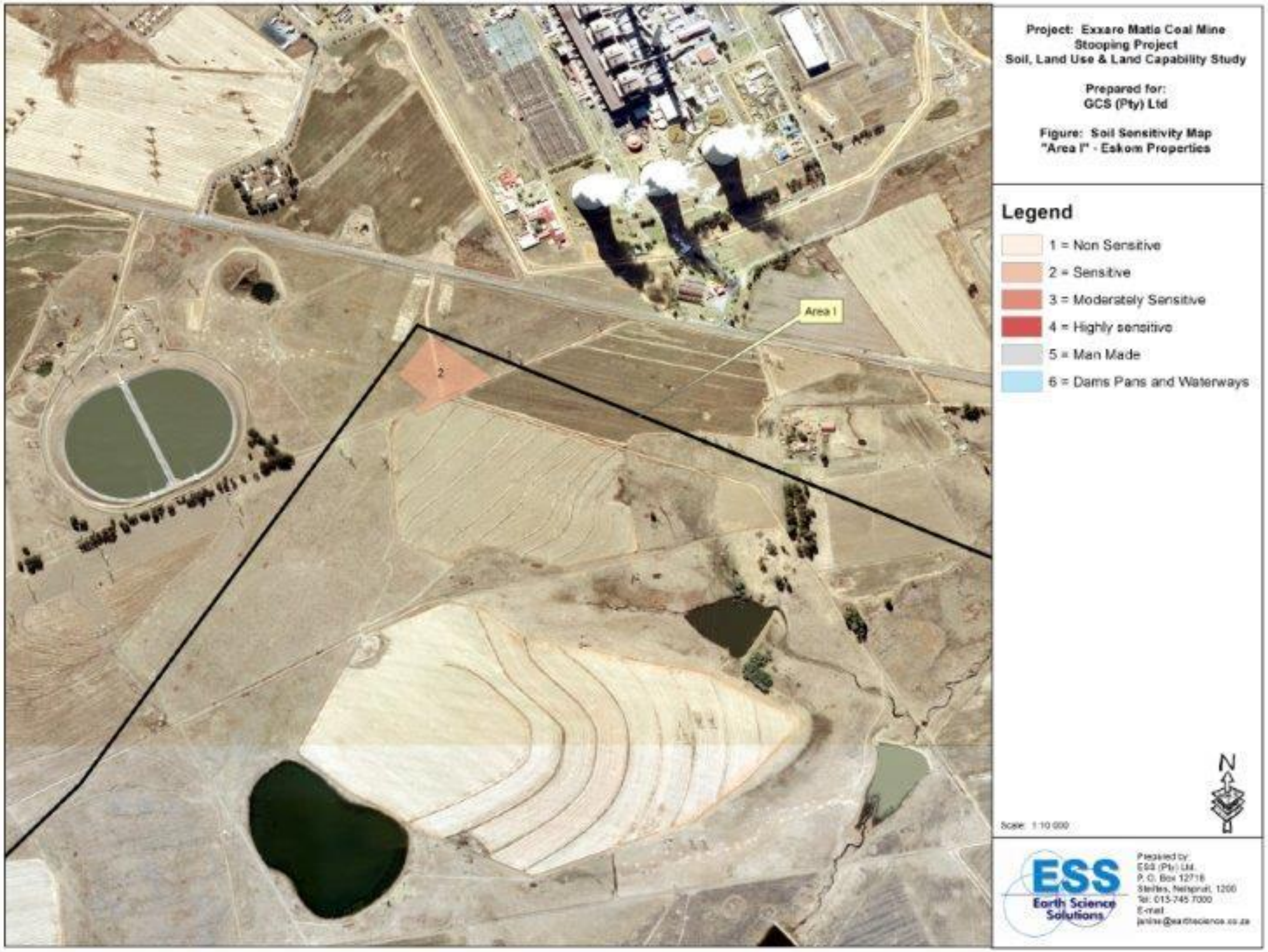
Project: Exxaro Matla Coal Mine
Stooping Project
Soil, Land Use & Land Capability Study
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Figure: Soil Sensitivity Map
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1 = Non Sensitive
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3 = Moderately Sensitive
4 = Highly sensitive
5 = Man Made
6 = Dams Pans and Waterways
Area I
2
N
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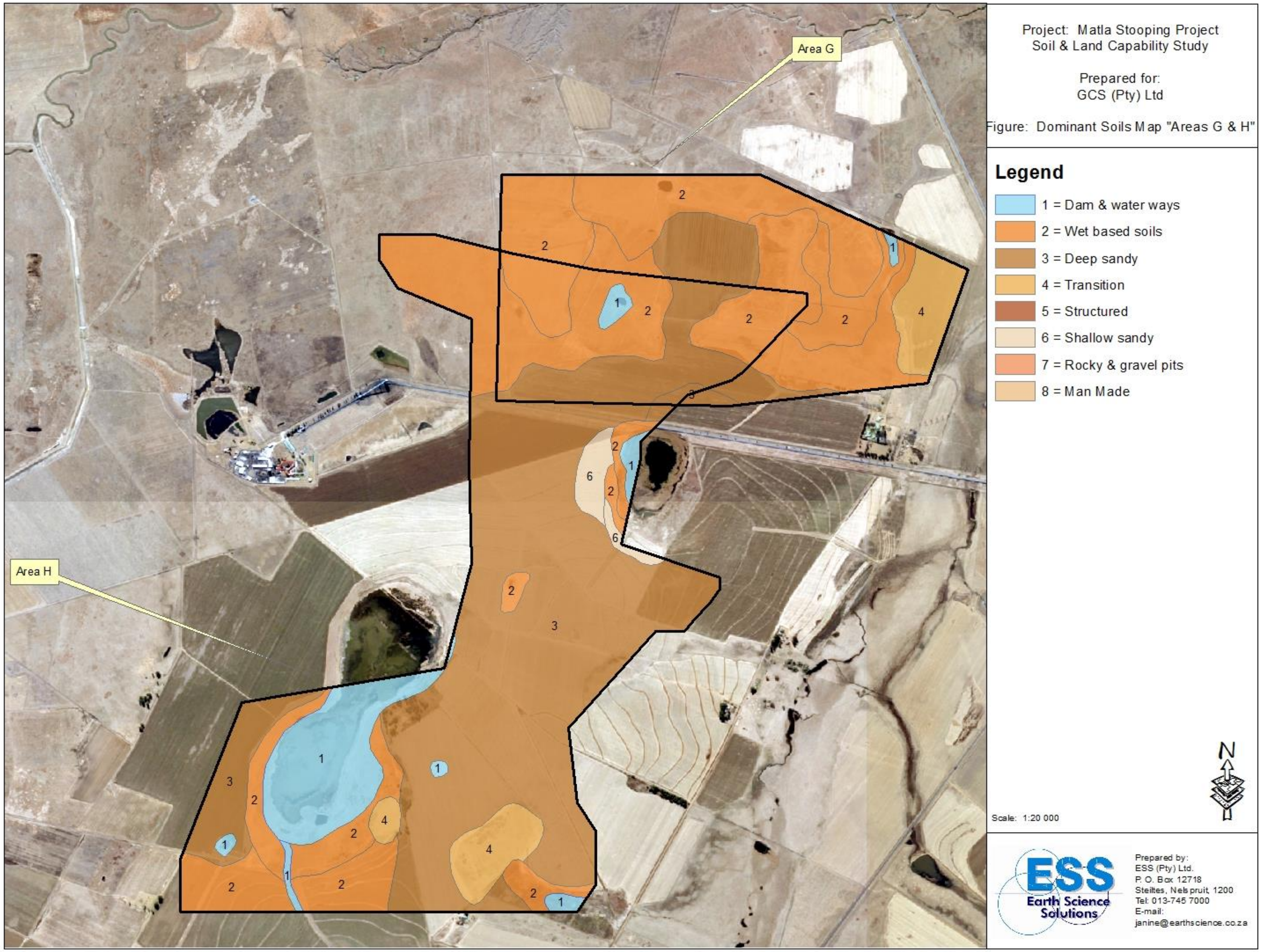
PHASE 2


Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Areas G & H"
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
Area G
Area H
N
Scale: 1:20 000
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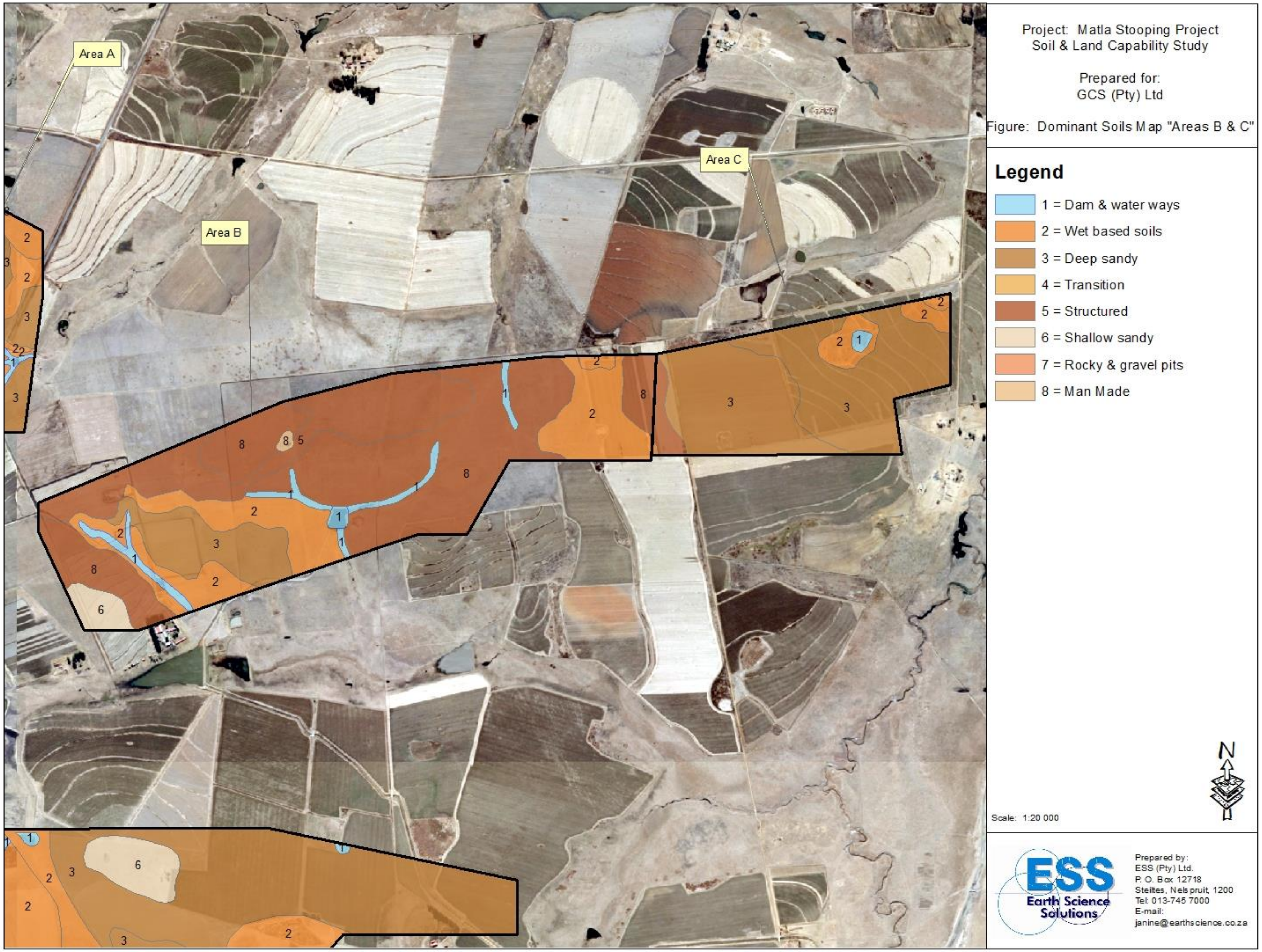
Area A
Area B
Area C
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Dominant Soils Map "Areas B & C"
Legend
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3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
N
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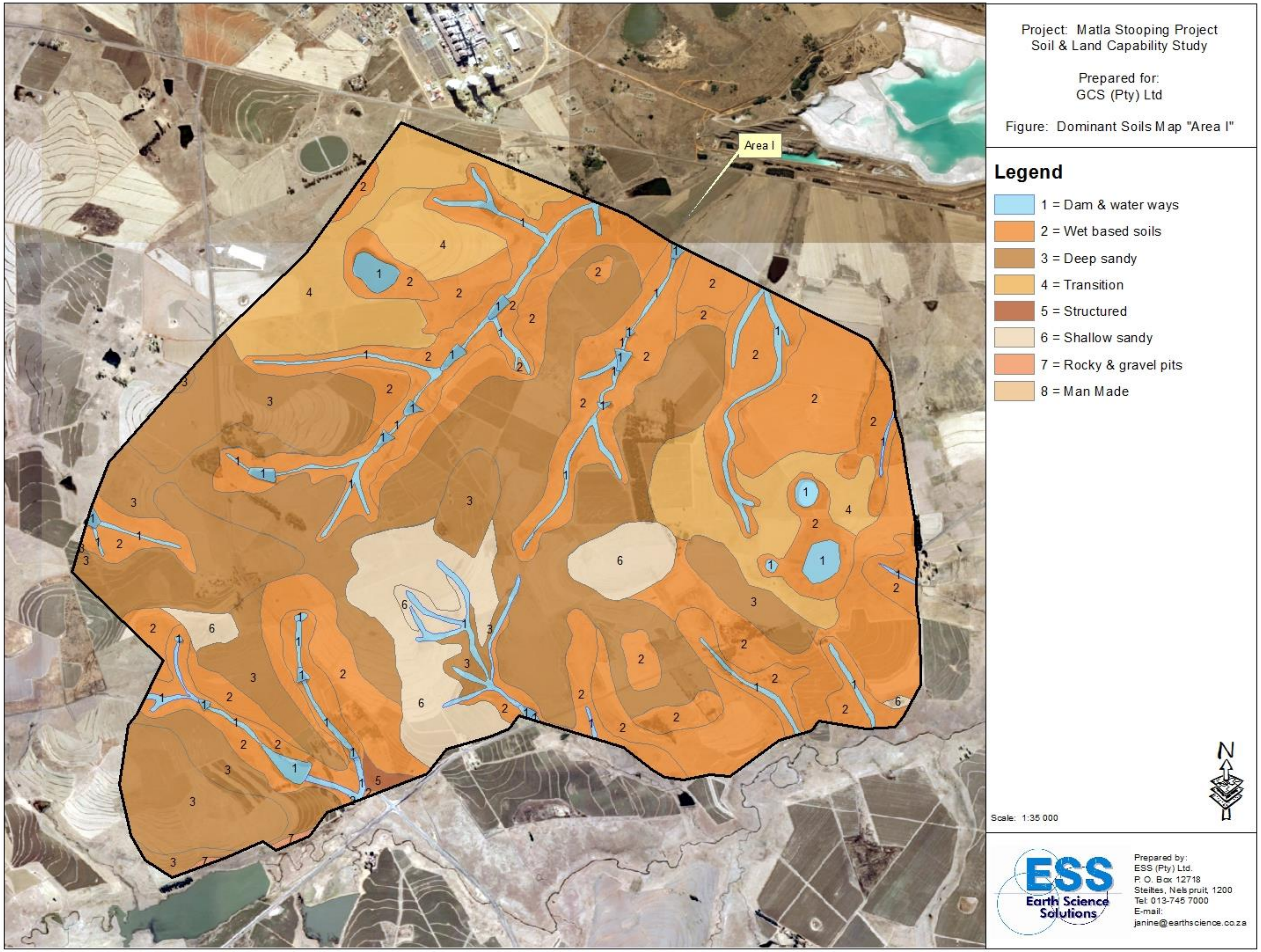
Area I
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Area I"
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
N
Scale: 1:35 000
ESS
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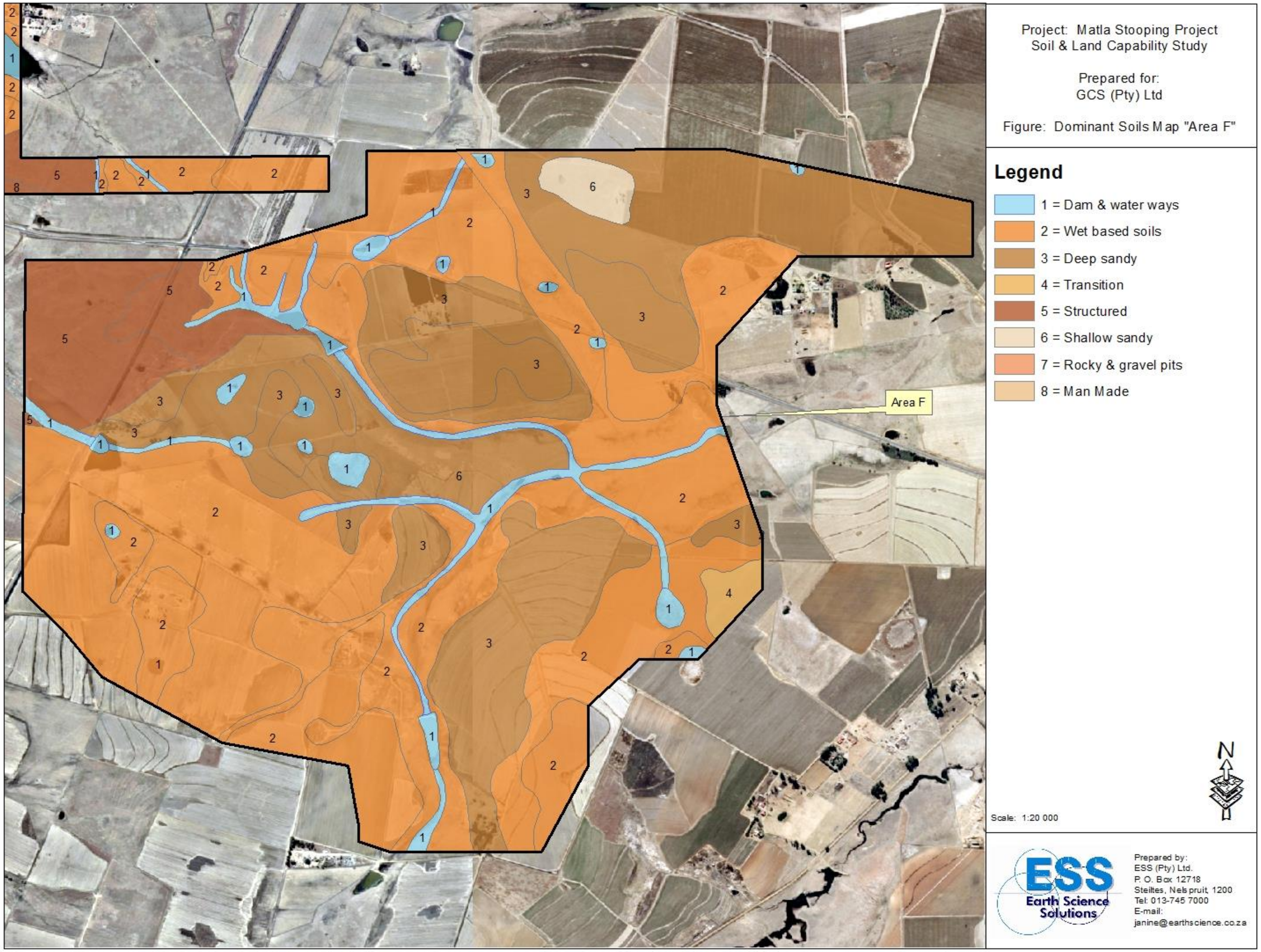
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Dominant Soils Map "Area F"
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
Area F
N
Scale: 1:20 000
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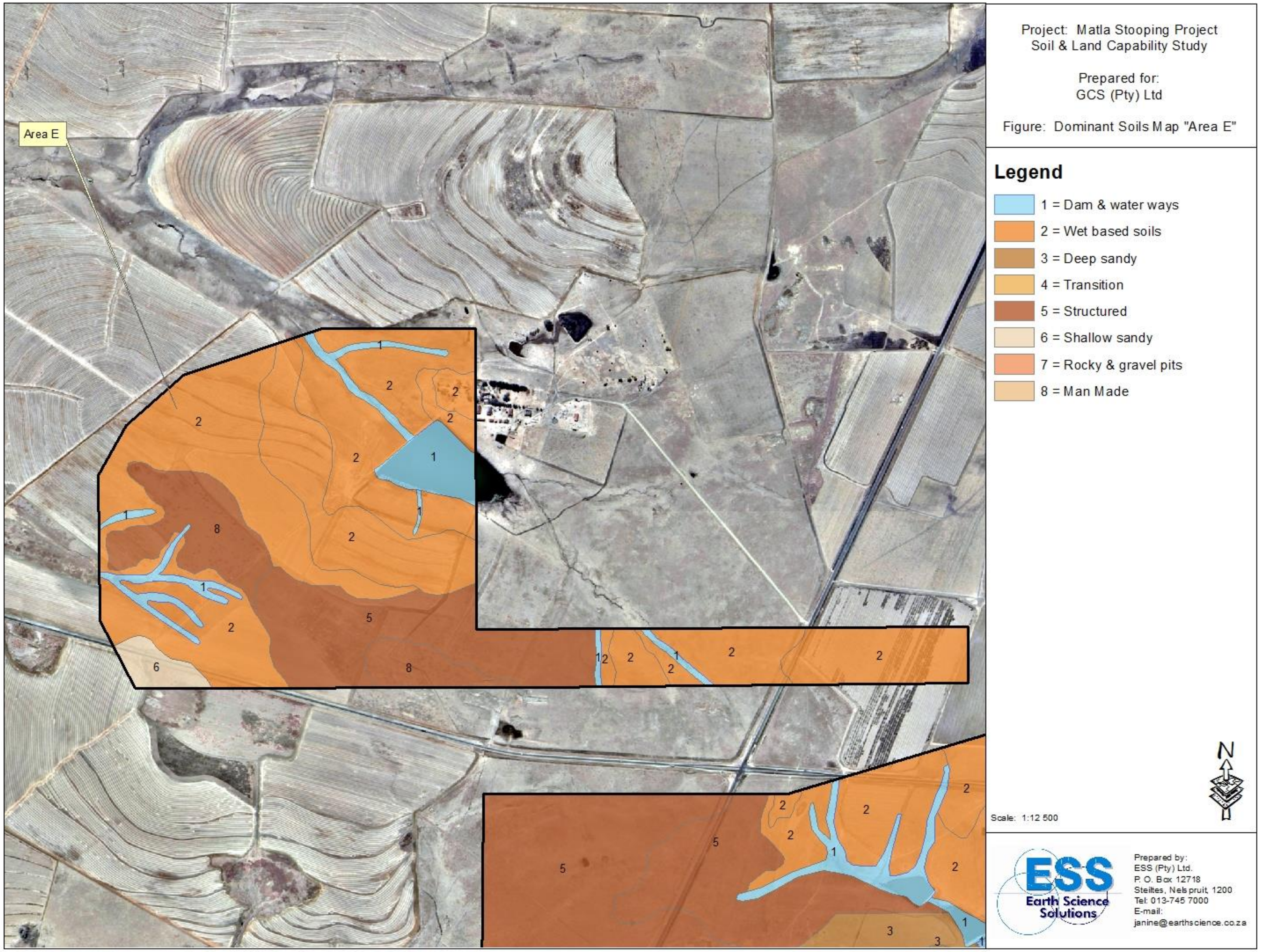
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Area E"
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
Area E
N
Scale: 1:12 500
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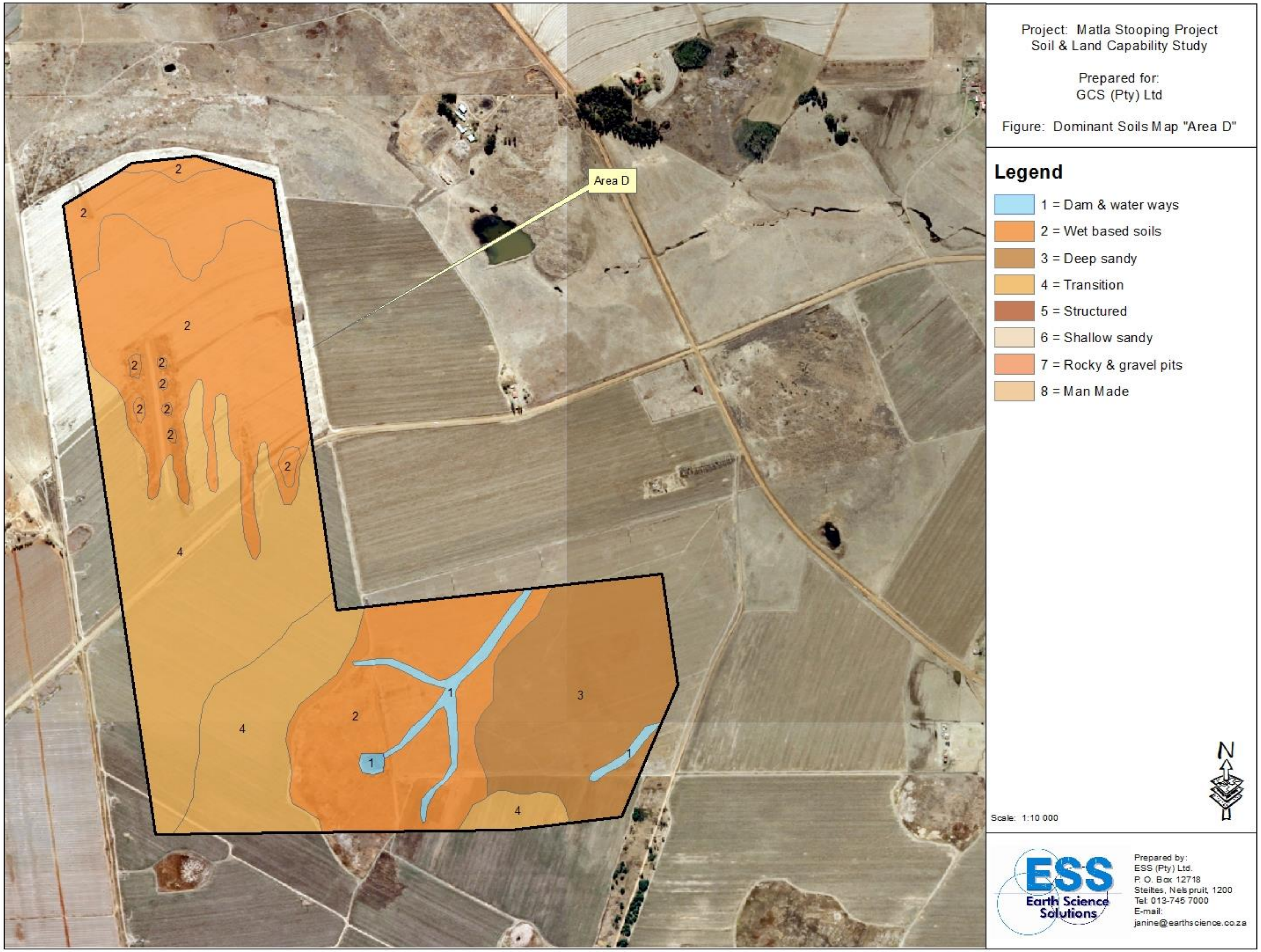
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Area D"
Legend
1 = Dam & water ways
2 = Wet based soils
3 = Deep sandy
4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
Area D
Scale: 1:10 000
N
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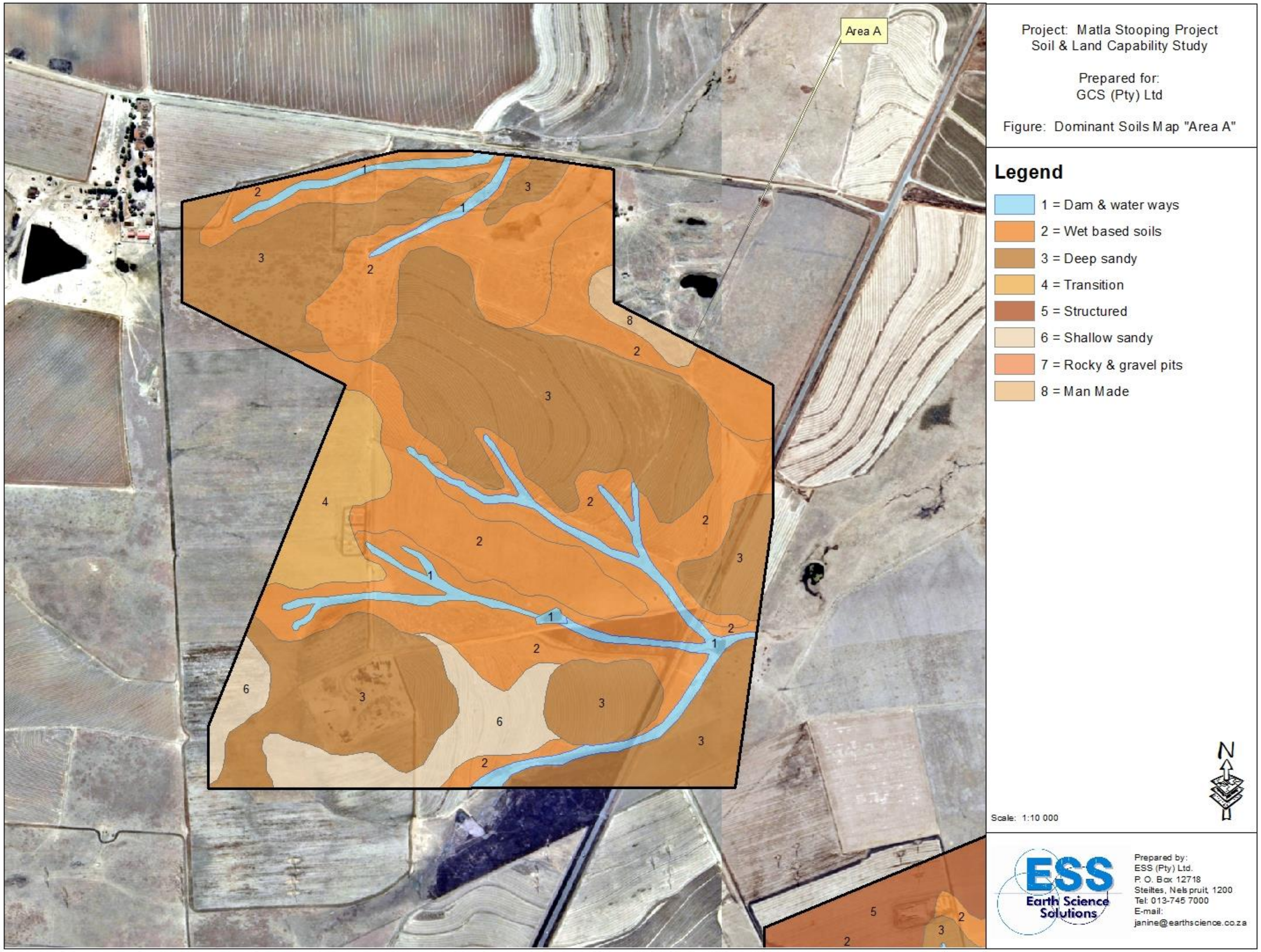
Area A
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Dominant Soils Map "Area A"
Legend
1 = Dam & water ways
2 = Wet based soils
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4 = Transition
5 = Structured
6 = Shallow sandy
7 = Rocky & gravel pits
8 = Man Made
Scale: 1:10 000
N
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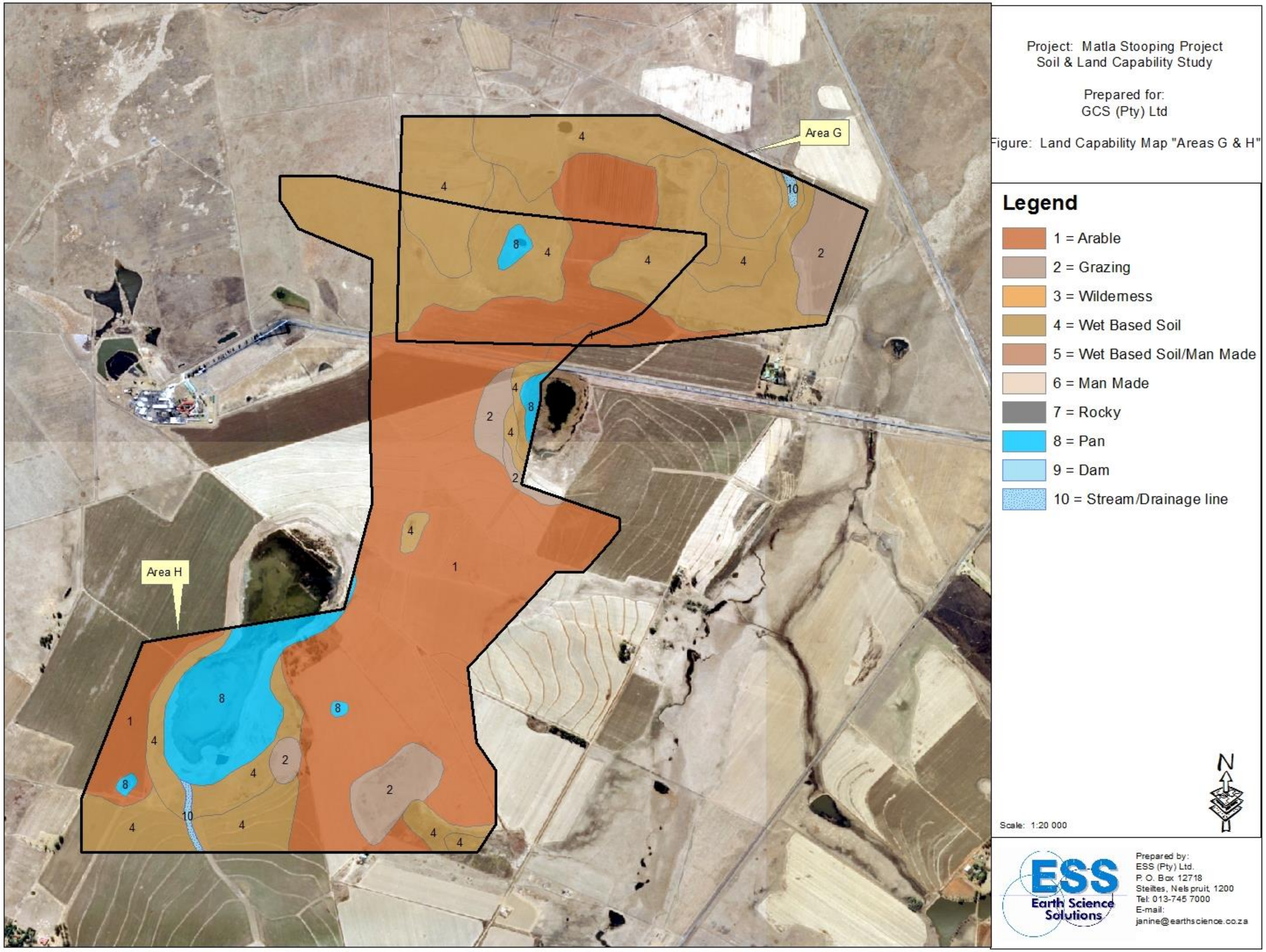
Area G
Area H
1
2
4
8
10
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map "Areas G & H"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
N
Scale: 1:20 000
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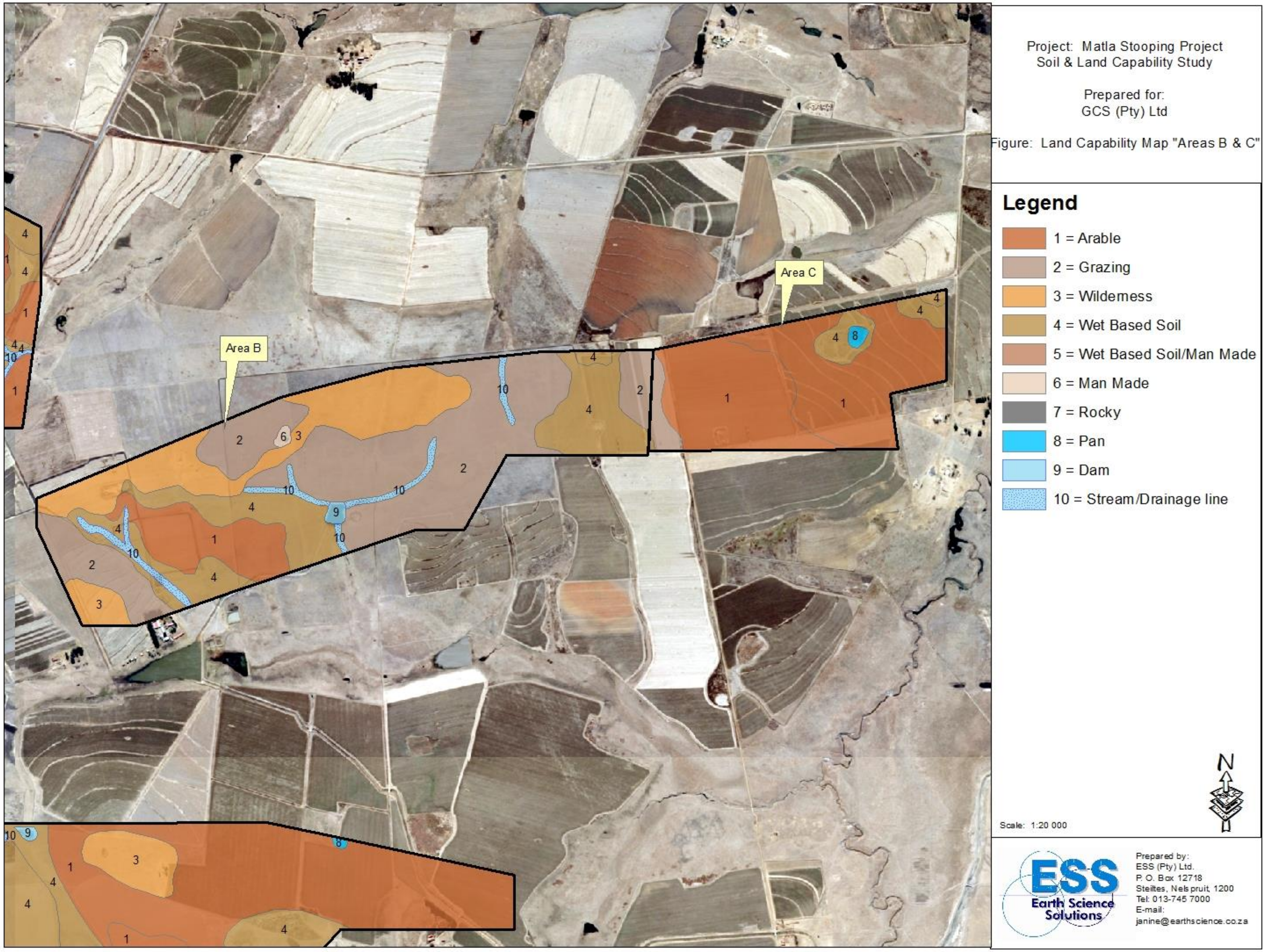
Area B
Area C
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map "Areas B & C"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
N
Scale: 1:20 000
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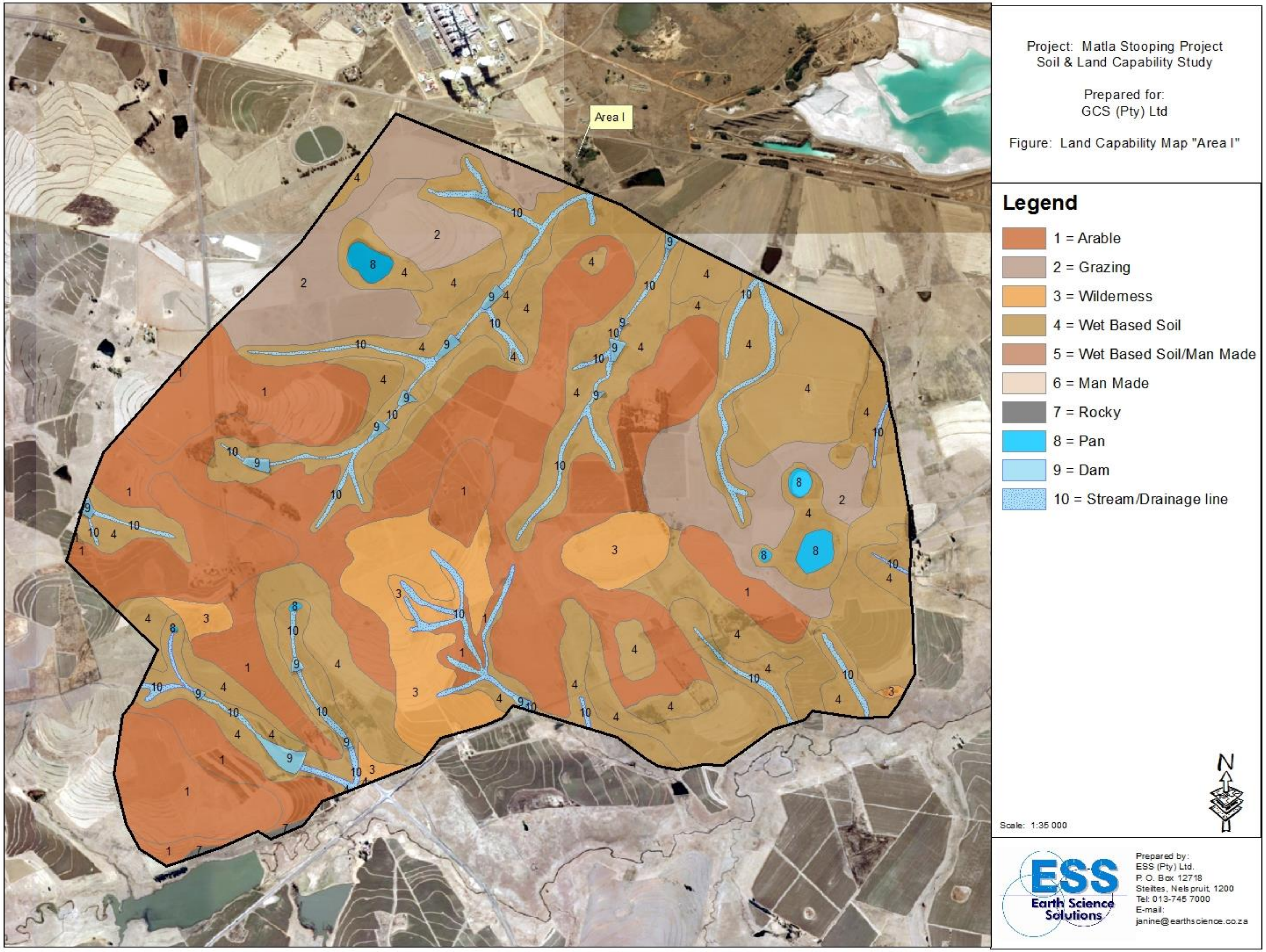
Area I
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map "Area I"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
N
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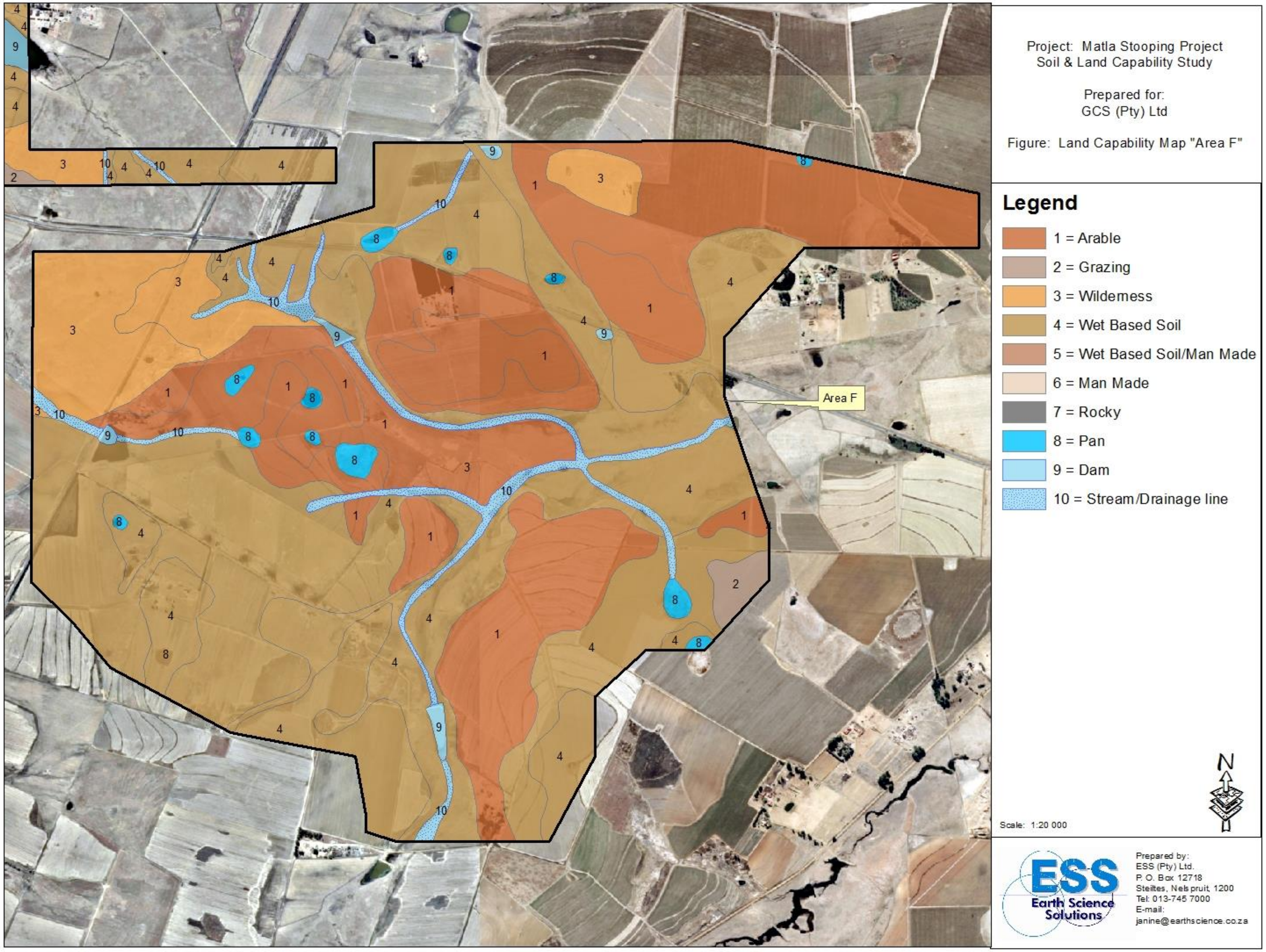
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map "Area F"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
Area F
N
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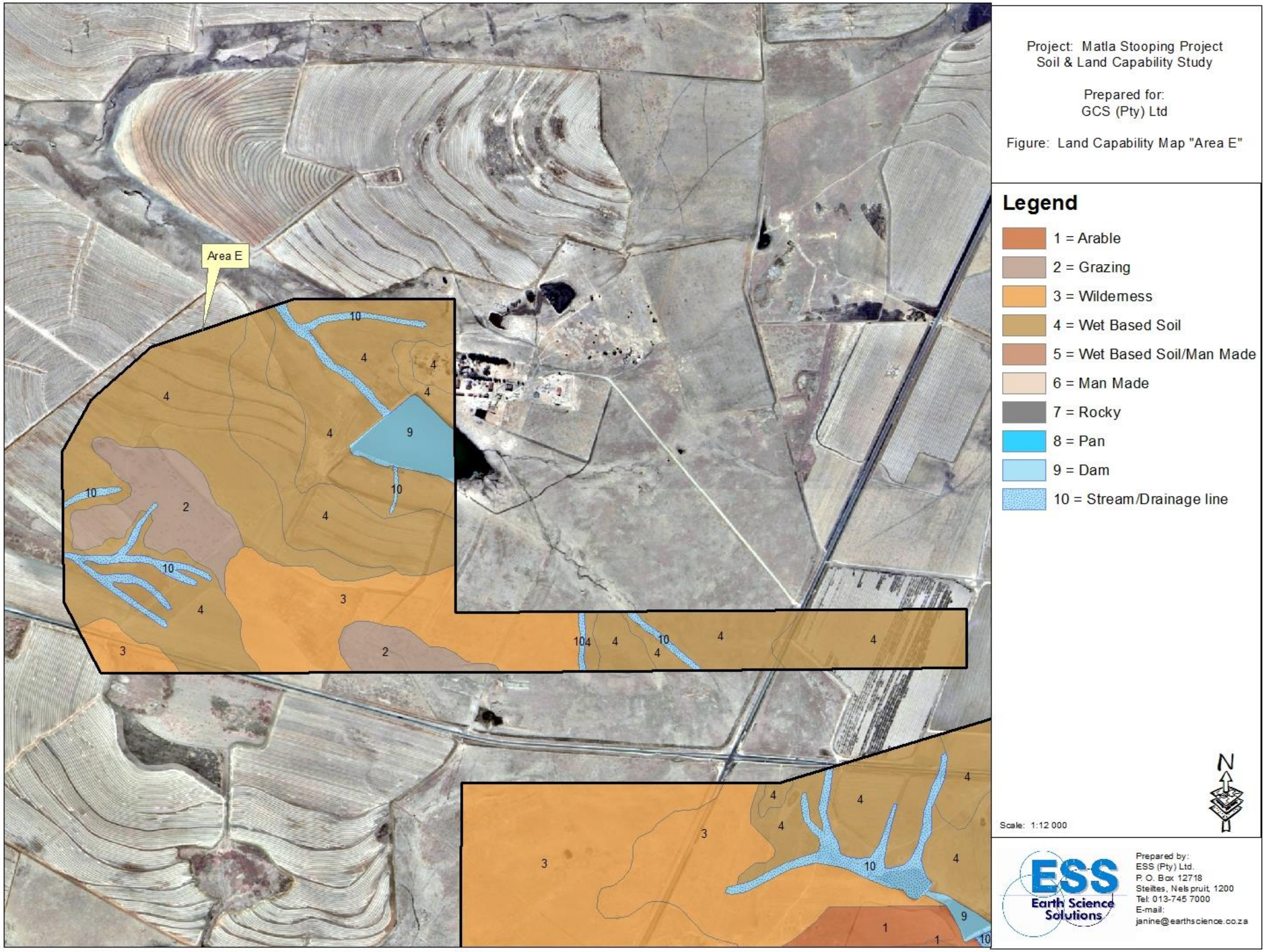
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Land Capability Map "Area E"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
Area E
Scale: 1:12 000
N
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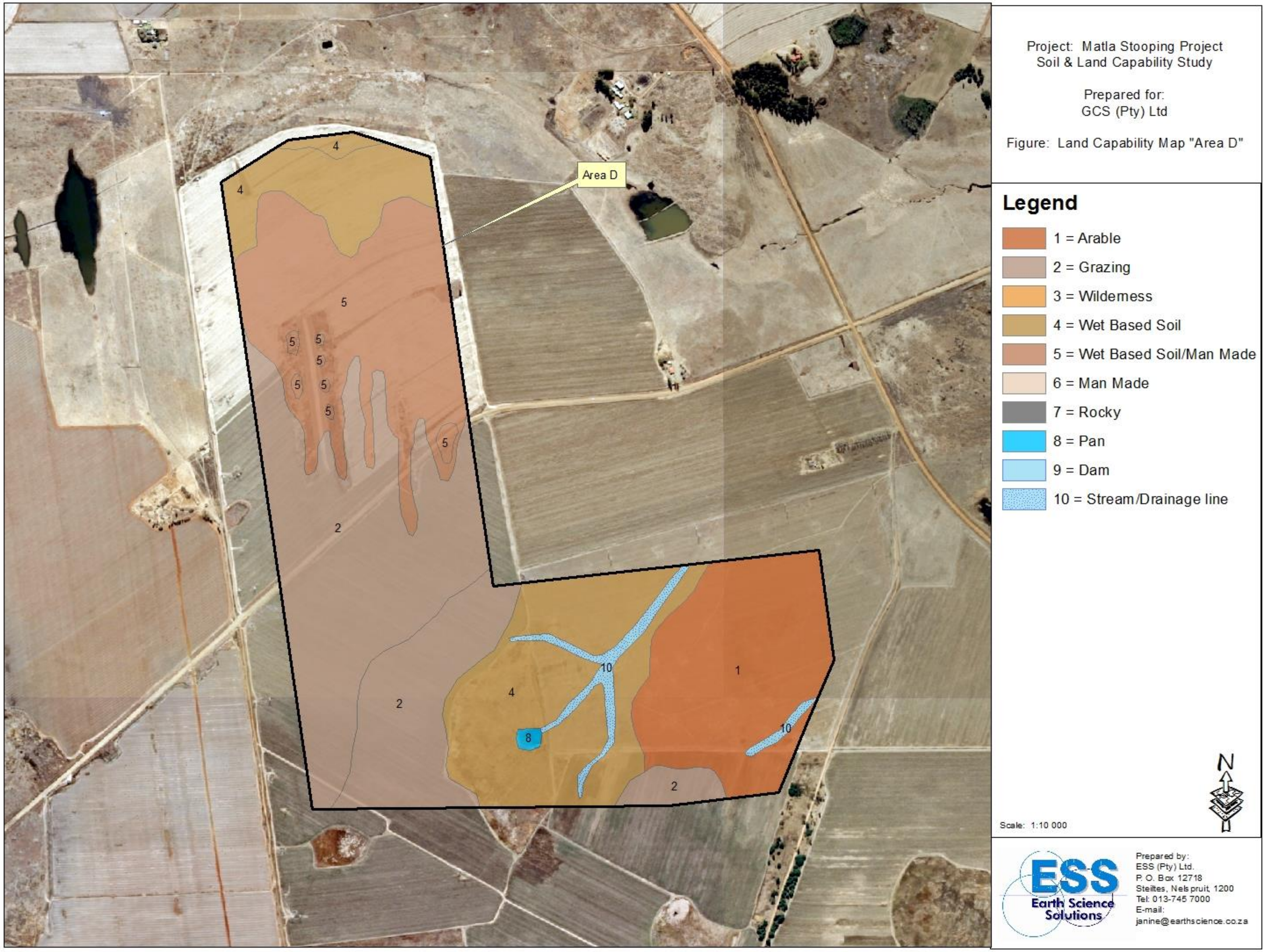
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Land Capability Map "Area D"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
Area D
N
Scale: 1:10 000
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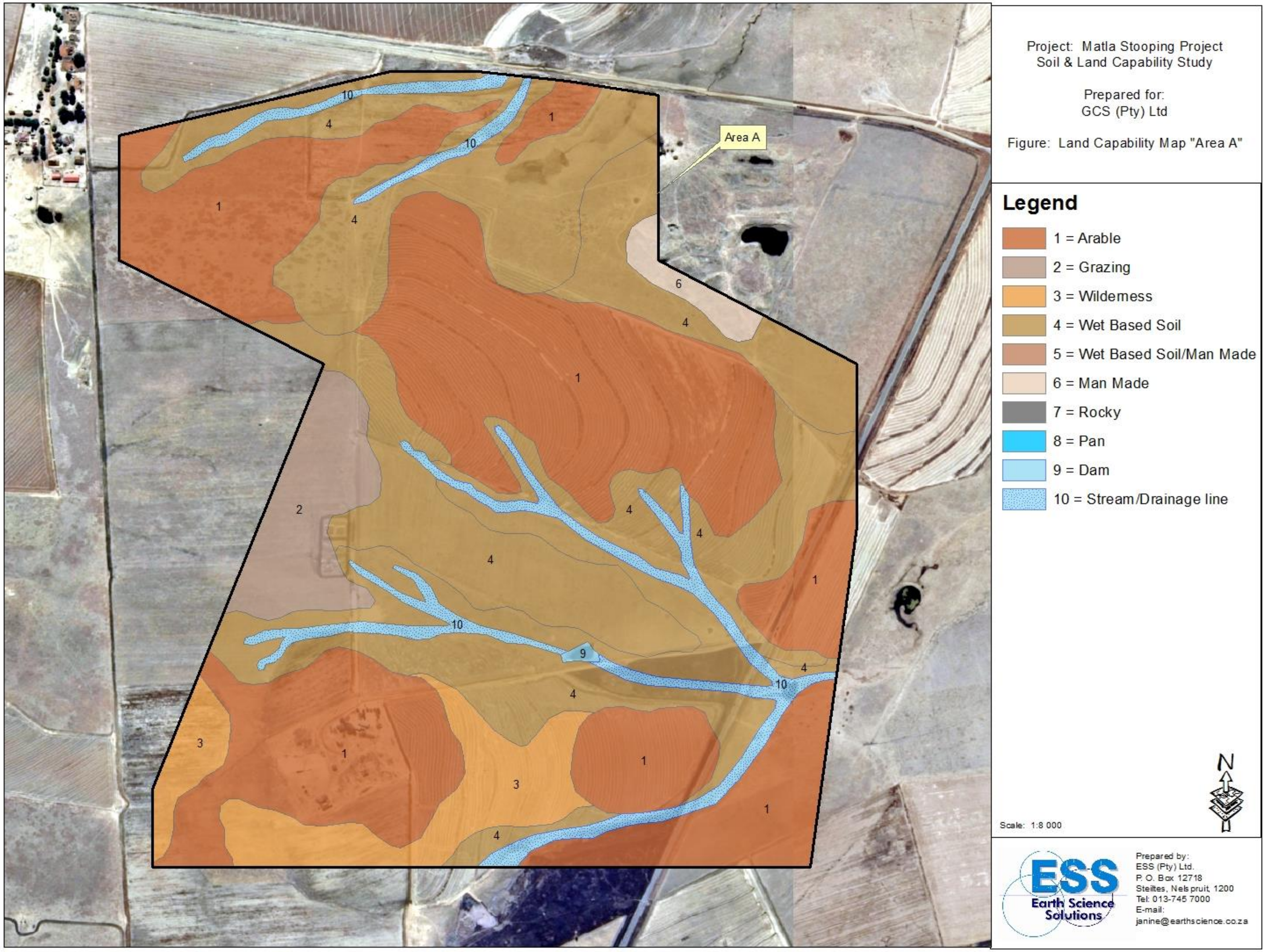
Area A
10
4
1
10
1
4
6
4
1
2
4
4
4
1
10
9
4
10
4
3
1
3
1
1
4
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Capability Map "Area A"
Legend
1 = Arable
2 = Grazing
3 = Wilderness
4 = Wet Based Soil
5 = Wet Based Soil/Man Made
6 = Man Made
7 = Rocky
8 = Pan
9 = Dam
10 = Stream/Drainage line
N
Scale: 1:8 000
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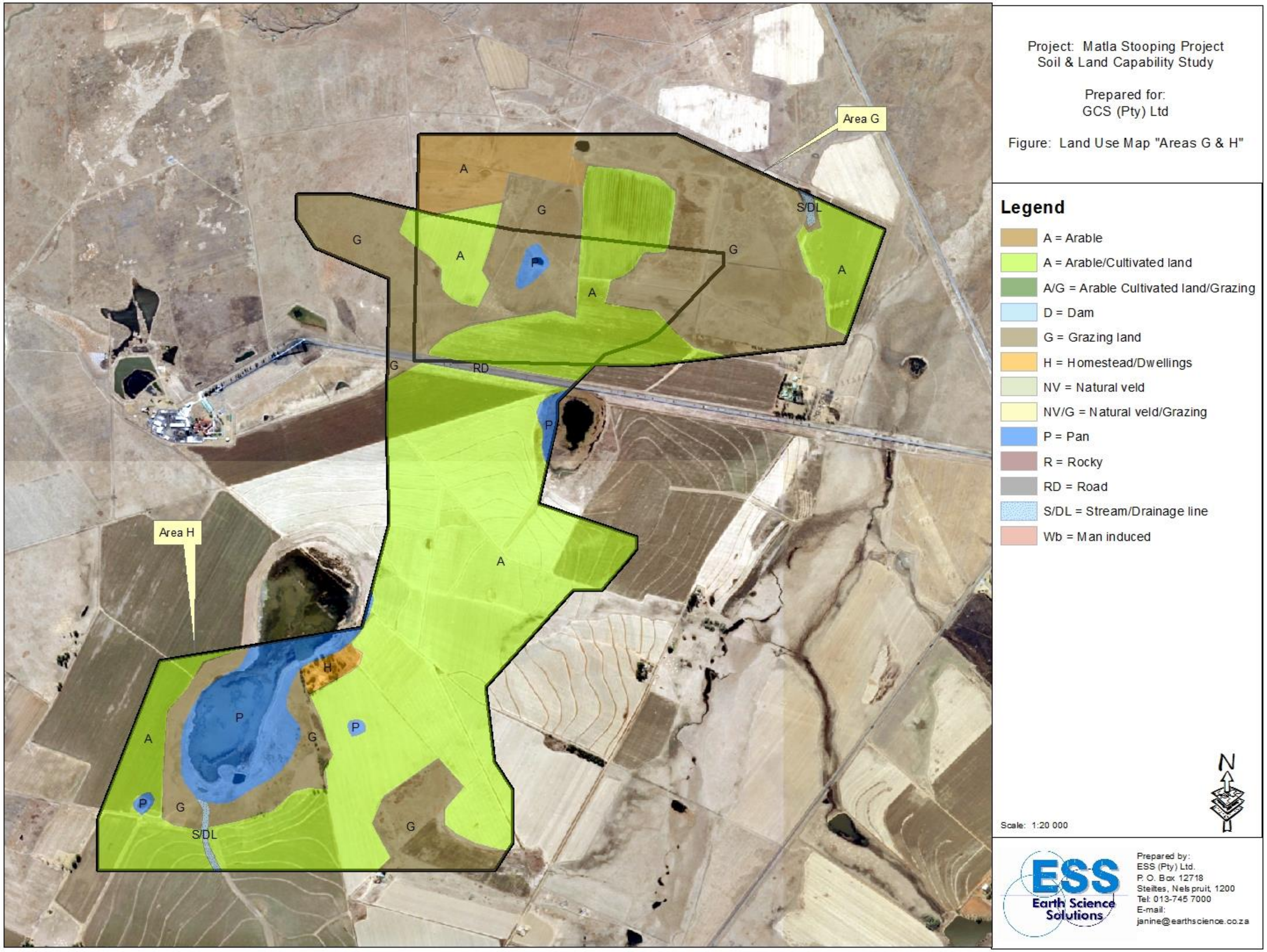
Area G
Area H
A
G
S/DL
RD
P
H
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Use Map "Areas G & H"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
Scale: 1:20 000
N
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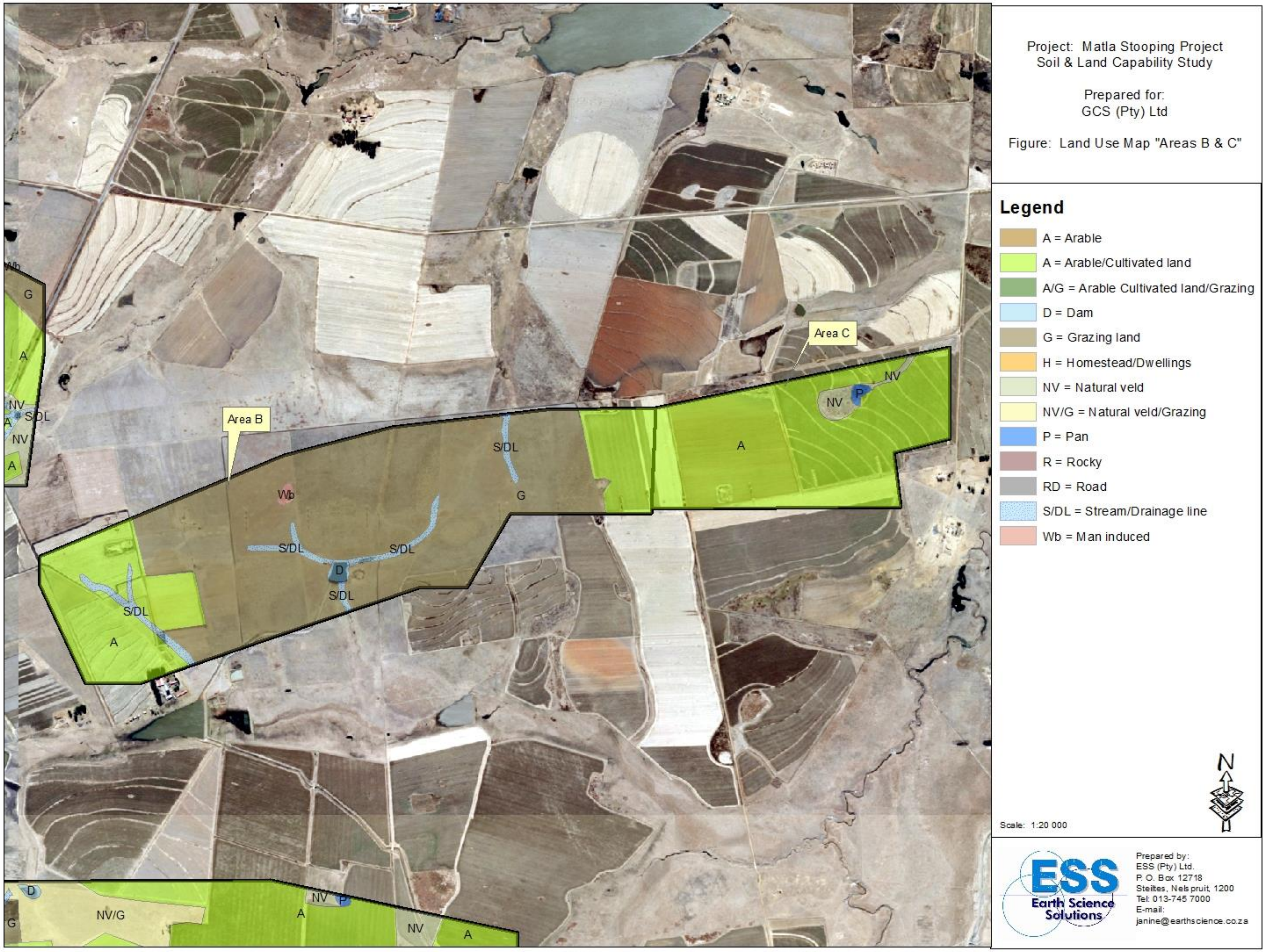
Project: Matla Stooping Project
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Figure: Land Use Map "Areas B & C"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
Scale: 1:20 000
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Area B
Area C
S/DL
G
Wb
D
A
NV
P
NV/G

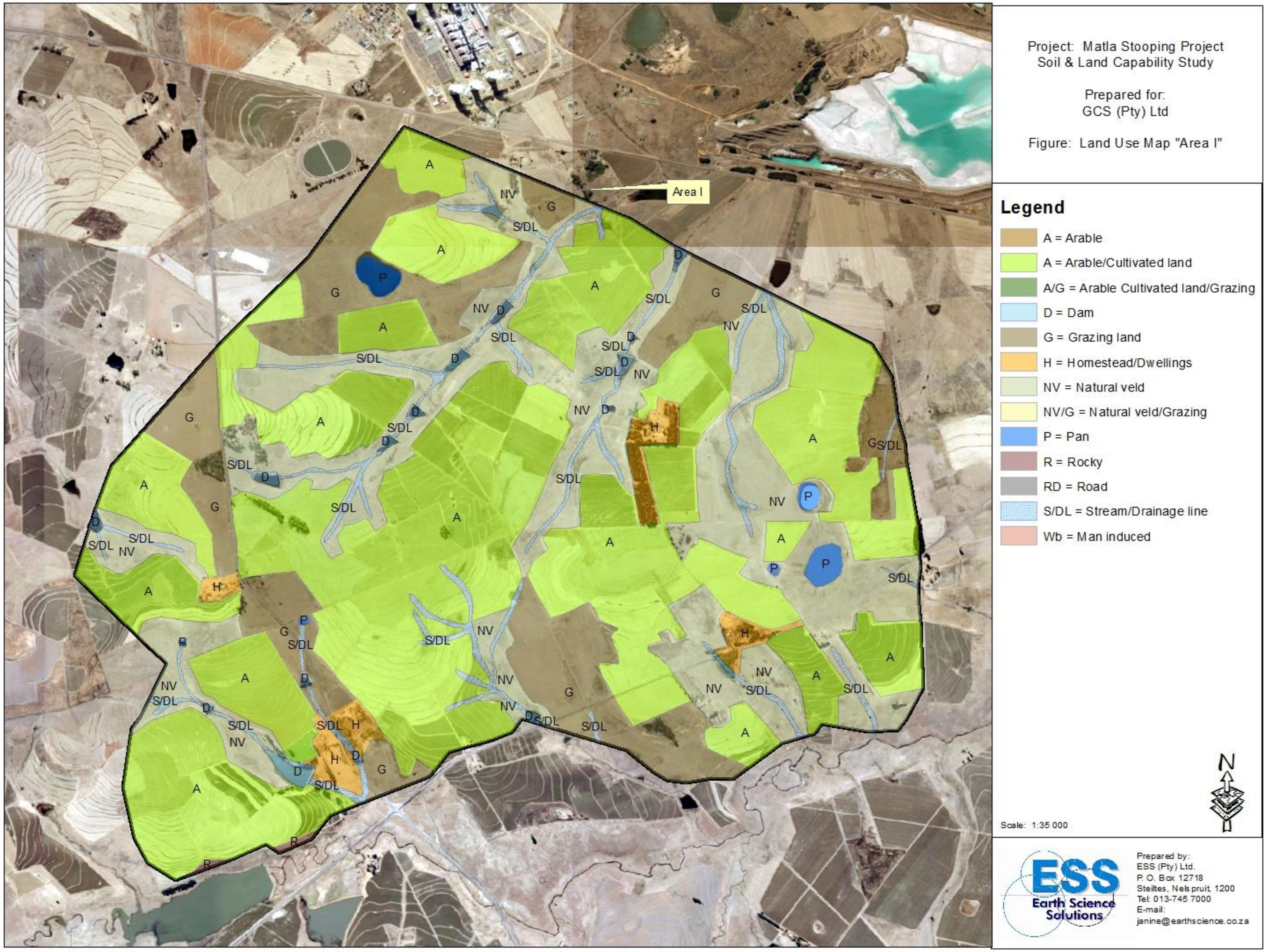
Project: Matla Stooping Project
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Figure: Land Use Map "Area I"
Area I
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
Scale: 1:35 000
N
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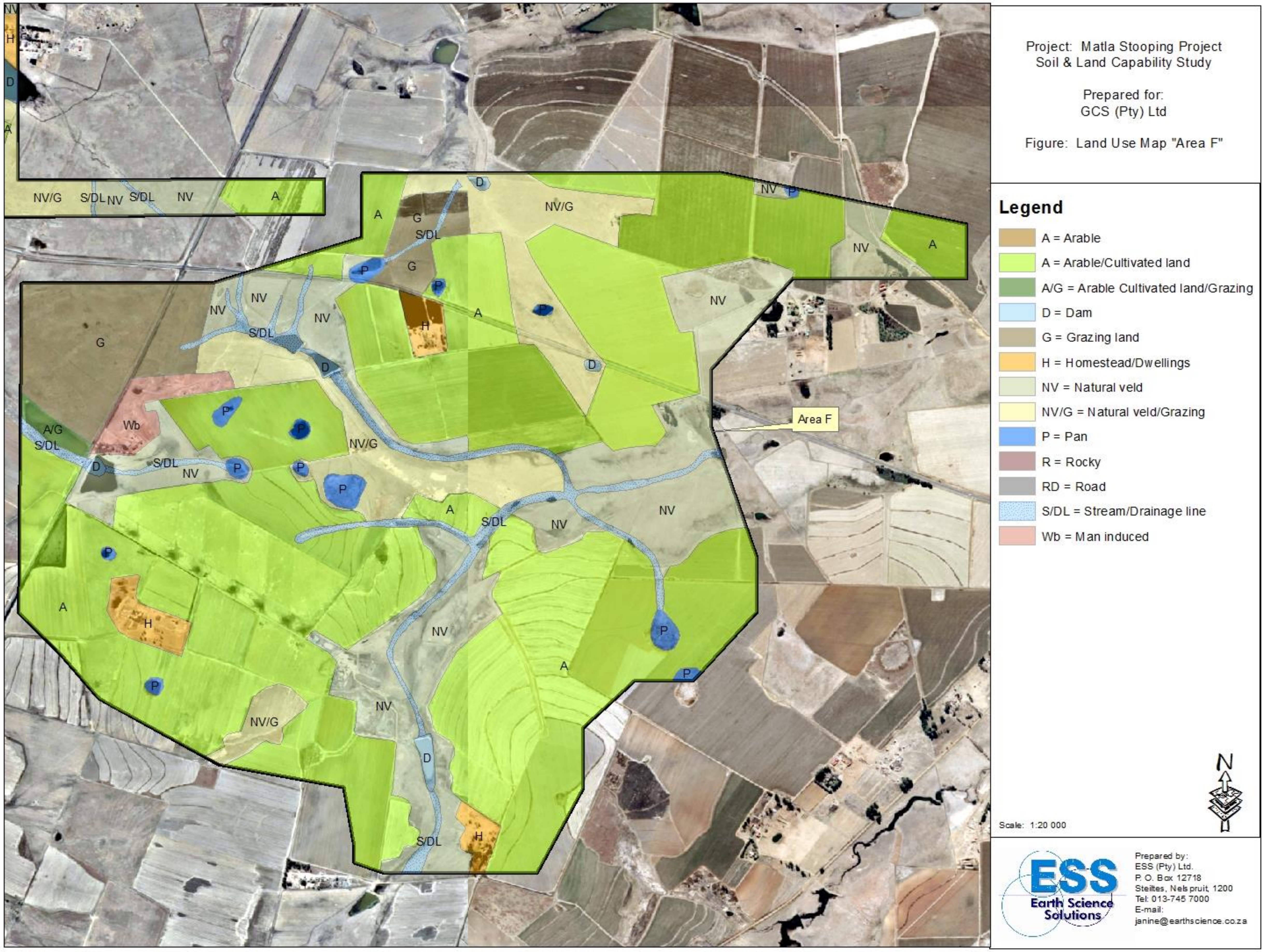
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Land Use Map "Area F"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
Area F
Scale: 1:20 000
N
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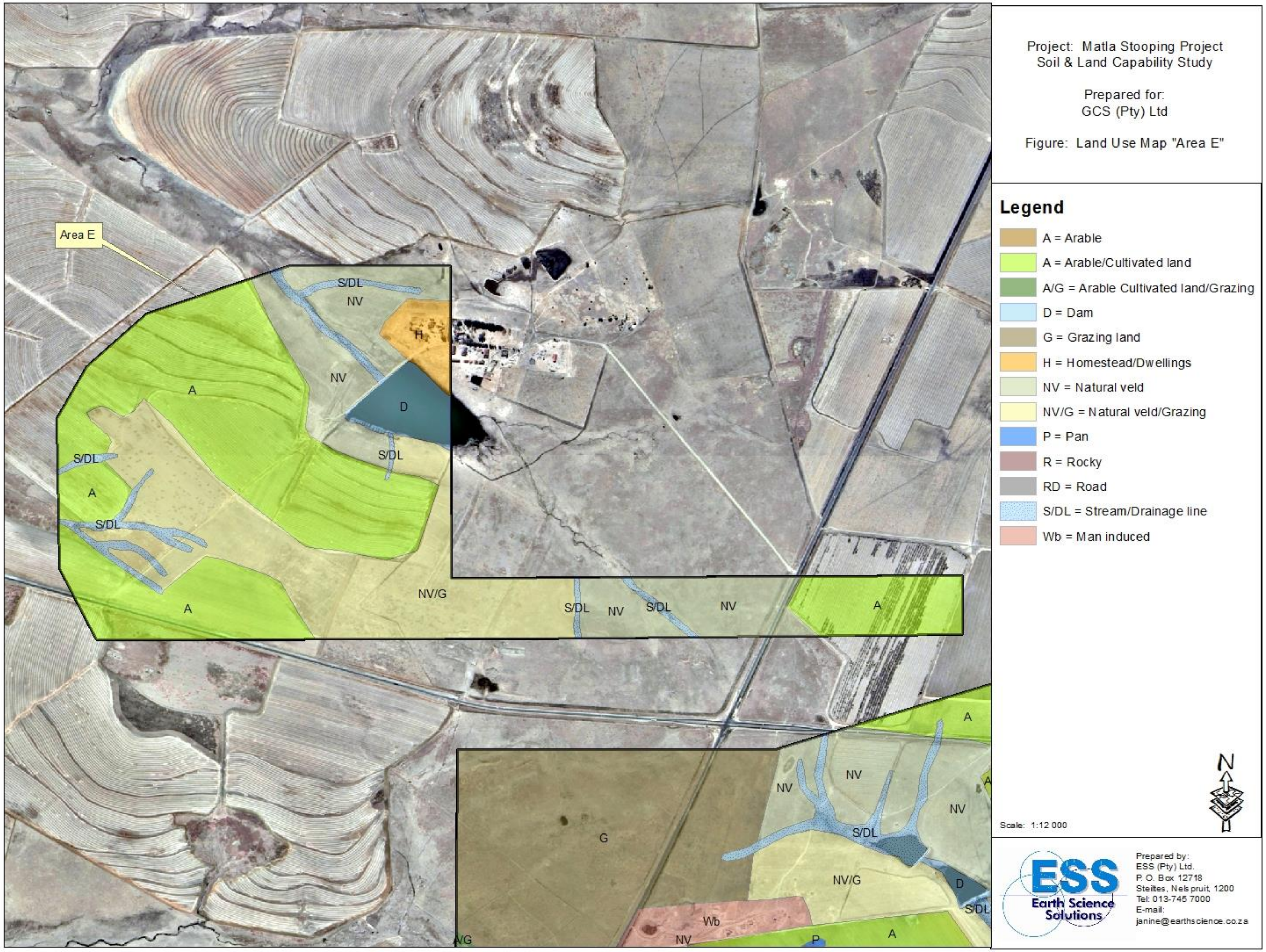
Area E
S/DL
NV
H
A
D
S/DL
A
S/DL
A
NV/G
S/DL
NV
S/DL
NV
A
A
NV
NV
NV
G
S/DL
NV/G
D
S/DL
Wb
NV
P
A
A/G
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Use Map "Area E"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
N
Scale: 1:12 000
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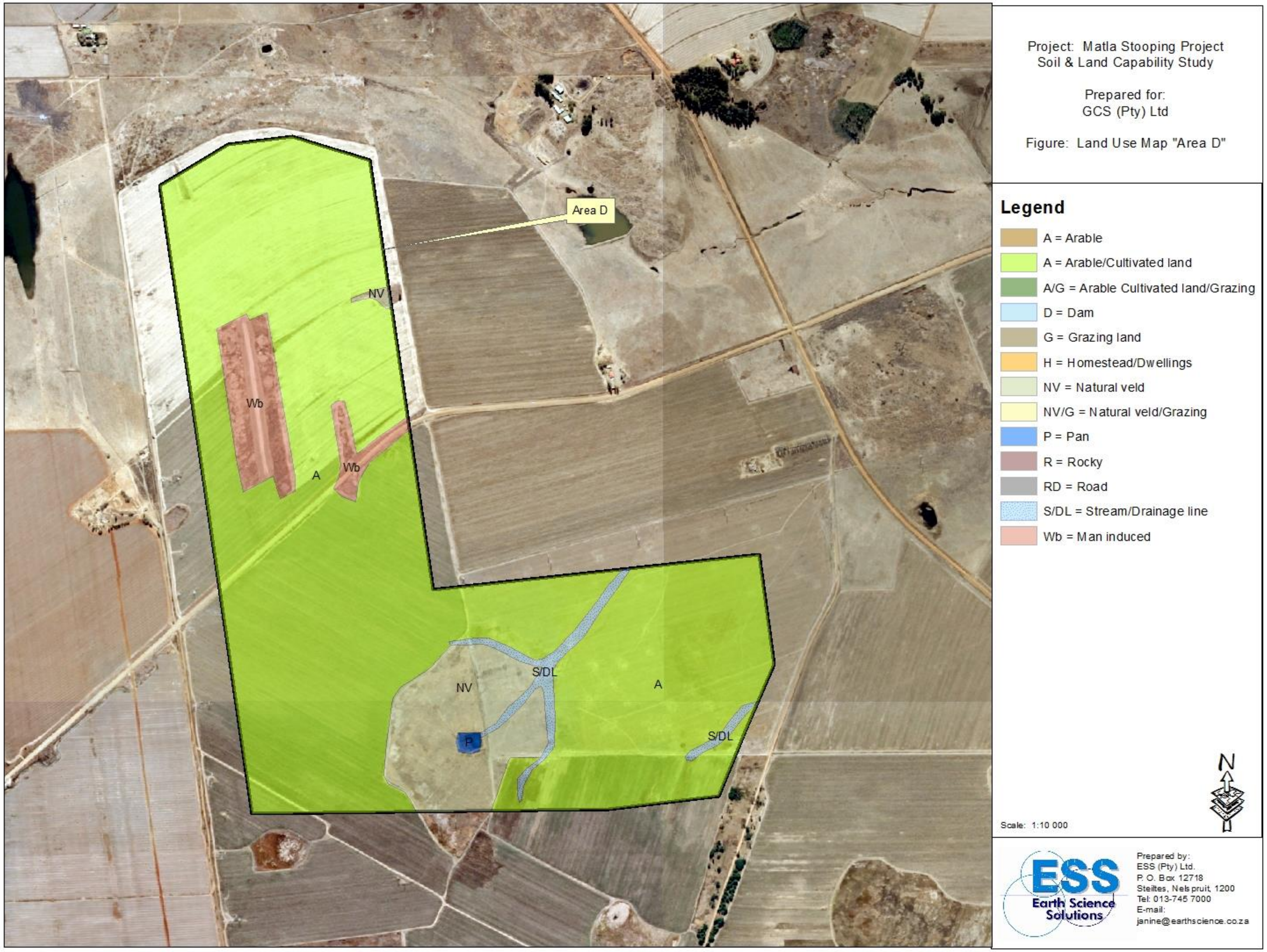
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
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Figure: Land Use Map "Area D"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
Area D
NV
Wb
A
Wb
S/DL
NV
A
P
S/DL
N
Scale: 1:10 000
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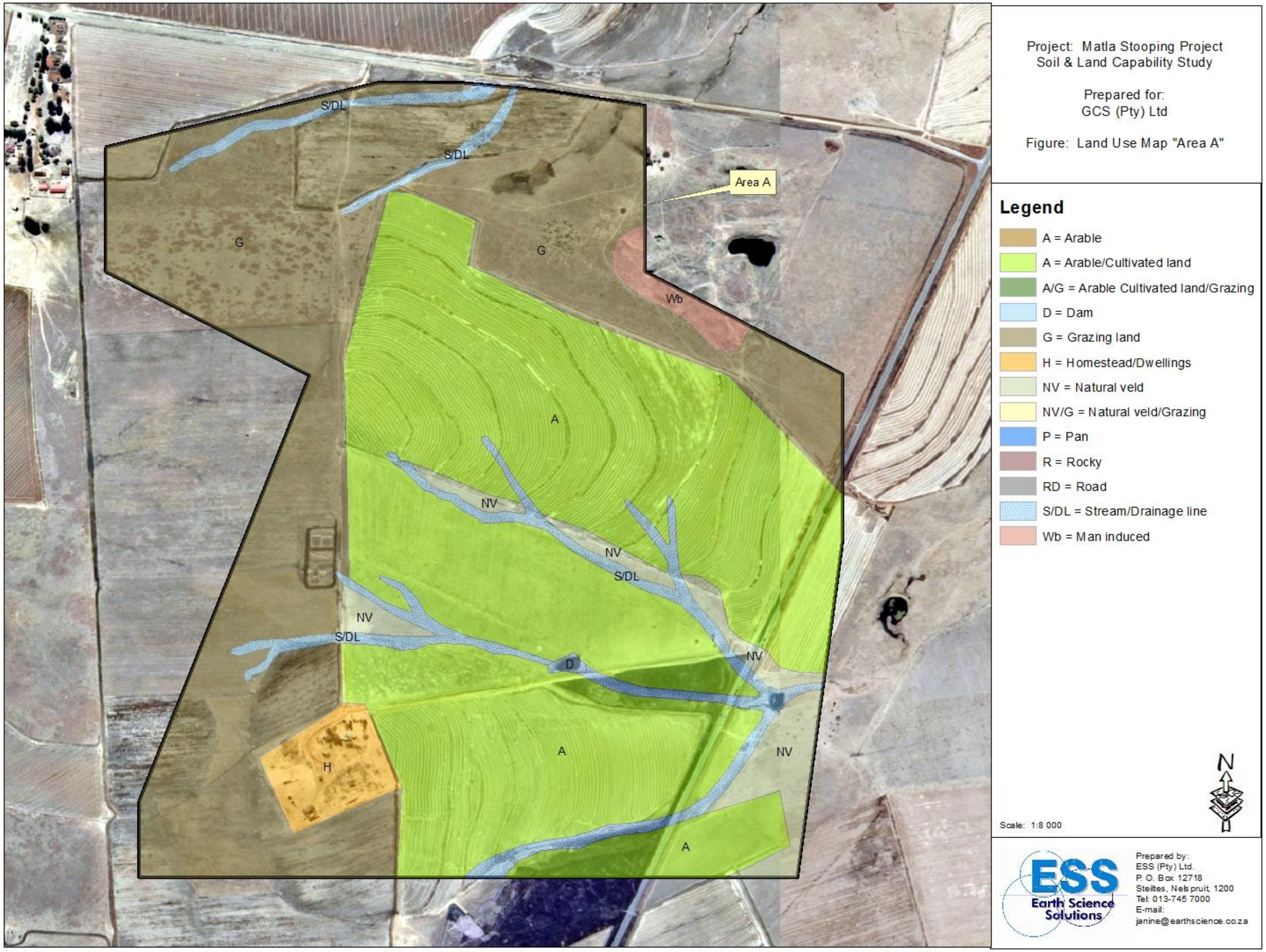
S/DL
S/DL
Area A
G
G
Wb
A
NV
NV
S/DL
NV
S/DL
D
NV
H
A
NV
A
Project: Matla Stooping Project
Soil & Land Capability Study
Prepared for:
GCS (Pty) Ltd
Figure: Land Use Map "Area A"
Legend
A = Arable
A = Arable/Cultivated land
A/G = Arable Cultivated land/Grazing
D = Dam
G = Grazing land
H = Homestead/Dwellings
NV = Natural veld
NV/G = Natural veld/Grazing
P = Pan
R = Rocky
RD = Road
S/DL = Stream/Drainage line
Wb = Man induced
N
Scale: 1:8 000
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APPENDIX 2

FERRICRETE CLASSIFICATION